THE

Malayan Agricultural Journal,

Vol. X. **Oct., Nov., & Dec., 1922.** **Nos. 10, 11 & 12.**

EDITORIAL NOTES.

STAFF:

Mr. B. A. R. Gater, B.A., Cam. Dip. Agr. reported his arrival on 18th December, 1922 and assumed duties as Assistant Entomologist.

"WHOLE" RUBBER:

Interest is being shown in a new method of preparation of rubber which consists essentially of the desiccation of latex by means of a special machine similar to that used in the preparation of milk powders.

When milk is desiccated it is possible, however, to convert the dry powder again into a fluid by the addition of water, although some of the constituents *e.g.* the proteins or nitrogenous substances, are probably changed to a certain extent. When latex is converted to a dry product by suitable means, it becomes coagulated and it is not possible to convert the dry product again into fluid latex.

This process of preparing rubber by the evaporation or desiccation of latex has been patented comparatively recently in many countries including Malaya and rubber of this type has been prepared by a large company in Sumatra and the raw product stated to be of excellent quality and superior to normal sheet and crepe rubber.

If the apparatus used in the preparation of this type of rubber is similar to that used in the preparation of dry milk powders the validity of the patent may be questioned, since this type of rubber has been prepared before on an experimental scale by the evaporation of latex in thin films in hot air chamber and also by sun-drying as in the Schadt process.

An article by the Agricultural Chemist on this rubber is contained in this number of the Malayan Agricultural Journal.

ROZELLE FIBRE:

Messrs. Durege and Thomas, Ltd., 8, Beach Street, Penang, inform us that they have recently erected a fibre baling press and are prepared to receive parcels of Rozelle Fibre for grading and baling.

The bale of 280 lbs. (8 to a ton weight) is pressed to 36" × 20" × 20", but the actual shipping measurement is somewhat in excess of this, because the bales expand after pressure has been released. Their charge is $3.00 per bale for grading and baling, receiving and shipping charges extra.

LOCAL FRUIT GROWING:

Private enterprise is doing more in the way of improving our local fruit supply than may be generally known. A Chinese in Singapore whose name can be supplied to enquirers, is producing oranges of exceptionally fine flavour and size; and he is also growing figs, though it is too early to say yet with what success. The oranges are very large and juicy and have an excellent flavour, a thin skin and few pips. The name of this grower who has not only fruit but also marcotted plants for sale, can be given to enquirers who are interested; enquirers should quote as a reference this number of the Malayan Agricultural Journal and D.A. 1636/22.

The Department of Agriculture also has the name of another grower of exceptionally good fruit who also supplies marcots (D.A. 1975/22).

There are also other gentlemen who are importing good varieties of fruit trees from Java and from India.

MALAYAN AGRICULTURAL JOURNAL:

This present issue of the Malayan Agricultural Journal includes Nos. 10, 11, and 12 for October, November and December, 1922, thus completing Volume X. These numbers have been combined in this manner in order to save the extra time required to produce and bind each separately. Subscriptions for Vol. XI, January-December, 1923 are now due and should be sent in as early as possible together with the printed order form enclosed. The subscription for the year is $5/- payable in advance—this includes Nos. 1—12 and the Index, together with Meteorological Returns for the whole year which will in future be issued as a Supplement at the close of the year.

COTTON EXPERIMENTS IN MALAYA.

By H. W. Jack and W. N. Sands.

COTTON of long-staple grades is not likely to be over produced in the sub-tropical and tropical countries of the world. Moreover, strenuous efforts, with large financial backing, are now being made by the recently formed Empire Cotton Growing Corporation to extend the culture of cotton in British Colonies and Protectorates in order that the cotton spinners of Great Britain may obtain adequate supplies of the raw material for their mills. Production of long-staple cotton is in danger or being restricted below normal requirements on account of the ravages of insect pests, and further the quantity available for British factories is steadily diminishing owing to the increased consumption of this class of cotton by American manufacturers.

That every effort should be made to grow long-staple cotton is emphasized by the fact that high-grade cotton is required by the rubber and motor industries. Next to rubber, long-staple cotton is the most important raw-material used by these and the outlook for the future is unsatisfactory because there is not enough of the best grades produced to meet the demand.

Attempts to grow cotton in Malaya have been made from time to time, but hitherto, the results obtained cannot be considered satisfactory from a commercial standpoint because the yield per unit area was either too low, or the quality produced was too poor.

About 1914, trials were made with Egyptian, American Upland and Caravonica cottons at the Kuala Lumpur and Batu Tiga Plantations, but the crop records of these experiments are not available. A comparatively good return, however, was reported. In 1921 a plot of Sea Island cotton was grown at the Kuala Kangsar Government Plantation. Owing chiefly to late planting, the yield obtained from it was small, but the Superintendent considers that the prospects of cotton-growing in the district are favourable.

At the Serdang Government Plantation, Egyptian and Sea Island varieties were planted last season. Here, also, the results were unsatisfactory, apparently on account of unsuitable soil conditions.

Both at Kuala Kangsar and Serdang the experience gained of the requirements of the crop is likely to prove valuable in connection with further experiments.

In other parts of the Peninsula the 'kidney' or 'chain' cotton, (*Gossypium brasiliense*), Caravonica, Egyptian, Assam Indigenous, Garo Hill, Dwarf Patani, and other varieties have been grown on a small scale by planters. With the exception of selected strains of Egyptian and Caravonica cotton all of these have coarse short staples, and are therefore of low value.

Although the prospects of cultivating the more valuable long-staple cotton in Malaya cannot as yet be estimated, still recent trials indicate that a fair measure of success may be anticipated in average seasons. It is true that new problems connected with the crop may have to be solved, but to date the difficulties which have been encountered are for the most part those which were anticipated and can be largely avoided by close attention to the requirements of the plant and the careful control of pests.

The writers are of opinion that it would be wiser to confine initial experiments to Egyptian and Sea Island types. These cottons produce the finest, longest and strongest staples; they command the highest market-prices and further, they are derived from the same species, *Gossypium barbadense*.

As the market for the finest Sea Island cotton is very limited, types producing moderately fine grades of this class of cotton should be grown; these together with selected Egyptian varieties are required in large quantities in Great Britain. The plants can be grown as annuals, that is, they would only occupy the land for about seven or eight months of each year; this is a great advantage because pests can be better controlled, as will be described later. Again the danger of natural hybridization and mixing of seed of long and short staple varieties would be avoided. Cotton from mixed, or hybridized seed is hardly saleable.

Should experiments with Egyptian and Sea Island cottons not prove satisfactory, then some of the best long-staple American Upland or other varieties might be tried, but it is doubtful whether the market value in Europe of the lint from these would be sufficiently high to make the crop remunerative, unless the yield per acre was heavy and the cost of production low.

Small experiments have been made by the Botanical Division of the Department during the past two seasons, chiefly with the object of obtaining a supply of pure seed of selected Egyptian and Sea Island varieties for larger trials. It may be useful to record the results of preliminary observations on these in view of the numerous enquiries that have been made in regard to cotton-growing locally, because they have indicated some of the difficulties that may be expected and the manner in which they may be met.

The following selected strains of cotton were grown:—

EGYPTIAN.

1. Assili F/21 — A selected strain of the well-known brown cotton extensively grown in Egypt.

2. Sakel E/21 — A selected strain of the excellent 'Sakel' cotton which is the most profitable of the varieties grown in Lower Egypt. It is produced in large quantities, and finds a ready market at high prices.

3.	310/A/21	A selected strain of a variety originally bred by Dr. Laurence Balls when he was in Egypt and now being largely cultivated. According to recent reports this variety is said to threaten seriously the position of 'Sakel' should it maintain its present promise, for in certain respects it is superior to that variety.

Sea Island.

4.	H/23	One of the best and most prolific of the West Indian strains. Originally selected in the island of Montserrat.
5.	A.N.	A good type of ordinary West Indian Sea Island cotton selected in St. Vincent.
6.	U.S.S./1	This is a prolific type selected in St. Vincent from a strain obtained from the United States.
7.	V. 18.	One of the superfine Sea Island strains raised in St. Vincent.
8.	V. 135.	A selected strain of one of the superfine St. Vincent cottons.

The Egyptian varieties were obtained from the Department of Agriculture at Cairo and the Sea Island from St. Vincent, British West Indies.

Time of Planting and Rainfall.

Cotton-growing when dependent on rainfall is usually a rather speculative undertaking. The plant succeeds best in places where the rainfall is good, but well distributed, during the first four months of its growth and then gradually decreases in the following three months when the bolls are maturing.

Judging from rainfall records it was thought that along the west coast of the Federated Malay States the optimum planting date would lie between the last week in February and the second week in March, and this has proved to be the case in the 1921 and 1922 seasons. Short dry spells occurred in March which delayed planting, retarded the germination of the seed, or inhibited the growth of the plant, but otherwise no difficulty was experienced. Cotton, once it is established, can withstand fairly dry conditions if they are not too prolonged. At the other end of the season the weather was all that could be desired and the bolls matured satisfactorily. It is a mistake to suppose that absolutely dry weather is essential at harvest. Good crops can be obtained, even if the weather is showery, provided the rains are not continuous and spells of sunshine intervene.

Soil.

As a rule light soils of good fertility are better than heavy ones. Provided the rainfall is not excessive, some of the heavier lands may

also prove quite suitable. On poor soils the growth is stunted and the yield low. On the other hand, very rich soils often induce rank vegetative growth which leads to poor crops. Good drainage of the land is essential.

The soils on which the experiments were made were light and recently cleared of "blukar." Some difficulty was encountered in establishing the plots for although the seed germinated well many of the seedlings died. This was thought to be due to the raw nature of the land and to deleterious products resulting from the decay of the large supplies of vegetable matter that were buried beneath the soil. No pests or diseases appeared to be responsible for the death of the seedlings. The land selected for the crop should therefore be worked up some time before planting is started, or preferably the cotton should be grown on land previously cultivated. When a considerable quantity of green dressing is present this material should be allowed to dry thoroughly before it is buried under the soil. There would be no danger in using well-rotted pen-manure on poor soils.

Preparation of Land.

The methods of preparing land for cotton vary a great deal. In Malaya with the ample rainfall, and the unlikely occurrence of long periods of drought, provided the season for planting is well chosen, the ridge system appears to be the one which should be adopted. For this method the land should first of all be clean-weeded and the weeds allowed to dry after being ranged in lines 4 or 5 feet apart. Ridges should then be thrown up either by plough or "changkol," covering the weeds completely. The ridges may be high or low, but preferably not less than 1 foot high at the centre. On good soils the ridges may be 4 or 5 feet apart: four feet is usually sufficient and on poor soils three feet. In dry districts the cotton may be planted on the flat. An advantage of the ridge method is that less cotton on the lower branches is damaged by rain and the root-system of the plants is better aerated. A water-soaked condition of the soil often leads to loss of crop because it checks the elaboration of food owing to root-asphyxiation, with the result that immature bolls are shed. Any factors however, which tend to limit elaboration of food, such as periods of rain, low rate of evaporation, or little direct solar radiation, are according to Mason (1), precursors of augmented rates of shedding.

The ridge system answered well in the experiments, and damage due to rain and soil-water was almost negligible. The ridges, however, were about 15 inches high and 5 feet apart. This spacing was too wide, a width of 4 feet would have given better results because the plants did not cover the ground well between the five-foot ridges. With ridges spaced at 4 feet, there would have been a larger number of plants per acre which would have given a larger yield and the weeding costs would have been reduced.

In one plot a large shade tree was allowed to remain and this seriously affected the growth of the plants over a considerable area surrounding it. Cotton cannot be grown successfully under shade, or near to large trees.

Planting.

The usual distance of planting the seed on ridges is two feet where the soil is of average fertility, but closer spacing may be given

(1) Annals of Botany. Vol. XXXVI, No. CXLIV, 1922.

on poor land. Three or four seeds are placed in small depressions about 1 inch deep, made with a stick and lightly covered with loose soil. After a period of seven days has elapsed, provided the weather is favourable, the young seedlings will be seen. Should vacancies occur, the holes where no seedlings are seen should be resown. The supplying of "dead holes" as early as possible is desirable. The seedlings should be thinned out when about six inches high leaving the two strongest in each hole. The young plants must be kept scrupulously clean-weeded. Shallow cultivation should be practised to avoid injuring the roots. Weeding may be continued until bolls are formed, or the plants have covered the ground, but it should not be unduly prolonged as it may damage the plants.

This practice was followed in the local trials. The spacing distance of 2 feet proved sufficient on the better portions of the land, but was too wide on the poorer sandy areas; in other respects the methods were found to be satisfactory.

Flowering and Bolling.

The plants grow to a height of 4 feet or more in suitable soil. The first flowers appear in two months from the time of planting and about seven weeks later, if all goes well, the bolls which develop from them open. Flowers appear in rapid succession after the plants have reached the age of two months. About the 14th week the largest number of flowers is produced, with the result that the maximum number of bolls matures about the 21st week. This number gradually decreases up to the seventh month. Should a second crop be obtained from the basal lateral branches which develop later than the primary branches the picking season may be prolonged by one to two months.

The cotton produced on the first-formed branches is, as a rule, better in quality than that from the basal laterals.

In our experiments the growth and bolling of the Egyptian and Sea Island plants in areas with suitable soil was quite up to the average of rain-grown cotton of these varieties in other countries and a yield of 200-250 lbs. of lint per acre was indicated.

Pests and Diseases.

The factors limiting the yield of cotton in the coastal districts of Malaya appear to be insect-pests, and not climate or fungus diseases, provided the time of planting is suitably chosen and soil conditions are satisfactory.

The following important pests, identified by the Government Entomologist, were recorded as causing damage to the stem, leaves or bolls:—

Cotton-stainer	...	*Dysdercus cingulatus.*
Leaf-roller	...	*Sylepta derogata.*
Hairy caterpillar	...	*Euproctis scintillans.*
Swarming caterpillar	...	*Spodoptera pecten.*
Boll-worm	...	*Earias insulana.*

The cotton-stainer proved a serious pest and was difficult to control owing to the presence of other food-plants in the vicinity of the plots. This insect feeds on the seeds of Kapok (*Ceiba pentandra syn. Eriodendron anfractuosum*), Roselle (*Hibiscus Sabdariffa* and *H. Sabdariffa var: altissima*), Hibiscus (*Hibiscus rosa-simensis*), Hemp (*Hibiscus cannabinus*), Okra (*Hibiscus esculentus*) and other malvaceous plants as well as cotton. The chief damage is done as a result of the punctures the insect makes in young and unopened bolls in its efforts to reach the enclosed seeds. The punctures allow deleterious bacteria and fungi to enter the soft tissues and destroy or stain the enclosed lint. The mechanical effect of the perforations is negligible, and if no disease germs or spores were present, the bolls would show white cotton only on opening. The extent and nature of the damage cannot be estimated, therefore, until the bolls are ripe. The obvious and only successful remedy is to adopt preventive measures against the pest by destroying all its known food-plants in the neighbourhood, and by the enforcement of a close season during which no cotton or other food plant is allowed to exist. Continuous trapping and collection of the insect is also advisable.

It is difficult to obtain good crops of white cotton if any of the food-plants mentioned above are allowed to grow near the cotton fields, because these plants enable the insects to breed and to tide over, in large numbers, the period when no cotton is growing. As cotton is the favourite food-plant of this pest, the latter is immediately attracted to it as soon as boll formation begins. Owing to the fact that the cultivation of 'Roselle' and 'Kapok' is being encouraged locally some difficulty may be experienced in controlling the pest. As 'Roselle' is grown for its fibre alone and is reaped before it reaches the flowering stage, no trouble need be anticipated in this direction, but if the plants were allowed to fruit then they would act as a serious menace to any cotton grown within three or four miles of them, unless of course the cotton-stainer was systematically destroyed when found on the Roselle and not allowed to breed.

In regard to 'Kapok' it was found almost impossible to get the people in the West Indies to harvest the pods thoroughly, hence it was necessary to enforce the complete destruction of all the trees in the cotton-growing islands. Owing to the relatively few 'kapok' trees grown locally at the present time, and their small size, it should not be difficult to make the owners of them harvest all the pods just before they opened, in any locality where cotton was being cultivated. If this was done there would be little danger of the pest spreading from the trees to the cotton.

The details of the various methods which can be successfully employed to keep the cotton-stainer under control cannot be given here, but they may be classed under the following heads:—

1. A close season of three or four months.

2. Trapping by means of cotton seed in the close season.

3. Hand-collecting.

4. Destruction of all known food-plants in the vicinity of the cotton fields.

5. Spraying with "tuba" mixture and other sprays.

The hairy caterpillar (*Euproctis scintillans*) damages the growing shoots and leaves by feeding on them, and boring into the stems, thus causing a severe setback. Where damaged shoots are seen they should be cut out and the insect killed. Quite a number of shoots may be injured by this pest in the early part of the season.

The leaf-roller (*Sylepta derogata*) is a pest which often causes extensive damage and nearly all the leaves on the plants may be damaged or destroyed and development completely arrested. Dusting or spraying with Paris Green or Lead Arsenate are effective remedies. All attacks must be dealt with as soon as observed.

The boll-worm (*Earias insulana*) is a rather serious pest as it feeds on the seed-cotton inside the boll and is difficult to control. So far, the attacks have not assumed large proportions, but the pest is capable of causing extensive damage. As an aid to the control of this insect a close season, during which all the old cotton plants are destroyed by burning or burying, is beneficial.

As mentioned above, these are the chief pests observed so far but there are others of less importance which were noted and should be treated. Cotton is a crop that requires careful watching throughout the entire period of its growth, and the success of its cultivation will largely depend on the early recognition of attacks of pests, and the energetic application of approved methods for their control.

Picking.

The cotton must be picked when the bolls are fully open and at fairly frequent intervals, especially in showery weather as prolonged exposure to moisture causes the seed to germinate and thereby renders it useless for planting purposes. Again if the seed-cotton is left too long it may drop from the boll to the ground and be soiled. It was found desirable to pick the cotton at least once in every three days in the local trials.

Cleaning, Ginning and Baling.

The methods of preparing long-staple cotton for the market need not be described here, but should any further information be desired by interested persons, on these or other points, the Secretary for Agriculture will be pleased to supply it.

Characters of Egyptian and Sea Island Cottons.

The results of the examination of the cottons in the laboratory are as under :—

No.	Class.	Max. lint length. (mean of 20 seeds) in m.m.	Wt. of seed (mean of 100) in grams.	Lint index in grams.	Ginning percentage of lint.
1	Egyptian Assili F/21	30 (= $1^{1}/_{5}$")	.1315	6.50	33.07
2	,, Sakel E/21	40	.1300	5.35	29.23
3	,, 380/A/21	37	.1255	5.27	29.46
4	Sea Island H/23	48	.1425	5.90	29.28
5	,, A.N.	46	.1300	4.80	26.96
6	,, U.S.S./1	39	.1245	5.70	31.40
7	,, V/18	48	.1270	3.95	23.72
8	,, V/135	50 (= 2")	.1130	3.75	24.91

Remarks on Cottons Tested.

No. 1.—A strain of the well-known Egyptian 'Assili.' Lint brown in colour, short, even, strong and fairly fine. The lint index and ginning percentage are both high. The bolls are small, but open widely, rendering picking easy and rapid.

No. 2.—A strain of the excellent Egyptian 'Sakel' cotton which closely approaches Sea Island in several of its characters and the uses to which it is put. The lint is white with a brownish tinge, fine, strong and even. Lint index and ginning percentage are satisfactory. The bolls somewhat resemble those of No. 1.

No. 3.—This is a strain of Bolls' No. 310. The lint is white with a brownish tinge, fine, fairly long and strong but appears to be inferior in length to No. 2 ('Sakel') as grown here.

No. 4.—The best all-round and most productive West Indian Sea Island strain. The growth and bearing characters are excellent. The bolls are large; the lint white, long, strong and fine. The lint index and ginning percentage are both high for this class of cotton.

No. 5.—A good ordinary strain of Sea Island cotton, lint fairly long, fine and strong.

No. 6.—This is a prolific type of Sea Island cotton. The lint is rather short and uneven, and the strain appears to be slightly impure. The lint index and ginning percentage are good.

No. 7.—A superfine type of Sea Island. The lint although fine, long and strong, is uneven. The lint index and ginning percentage are low as is usual in this class of cotton.

No. 8.—This is another superfine type which is superior in most respects to No. 7.

The lint index is the lint contained on 100 seeds expressed in grammes. This is found to be a more reliable indication of the productive value of a cotton than the lint percentage, provided that the different strains of any one variety under test are capable of bearing the same number of bolls.

From observations in the field and laboratory the Egyptian and Sea Island types which are likely to prove particularly useful in further experiments are Nos. 1, 2, 3, 4 and 6. It is hoped that by selection and hybridization good types suited to local conditions may be isolated from them. The cottons are quite up to the required standard for such work, and compare favourably with similar forms grown elsewhere.

As mentioned before, there are a few species and varieties found growing in different parts of the Peninsula : these have been collected and tested, besides, several samples of cotton from them have been submitted by planters for report. The result of the examination shows that there is little likelihood of any of the cottons proving suitable for commercial purposes.

Frequent enquiries have been made concerning the value of the common "chain" or "kidney" cotton (*Gossypium brasiliense*) which is widely distributed in Malaya so that it may be well to give the following extract from "The Commercial Products of India" by Sir George Watt.

"All the nations of the world seem for a time to have vied with each other in the attempt to acclimatise the Brazilian Cotton, and in each new country to which taken it obtained the name of the region from whence immediately conveyed ; accordingly in Burma, and also in the Antilles, it is called "Siam Cotton," and in India "Ava Cotton," etc. Roxburgh tells us in the MS. edition of his *Flora Indica* (Preserved in Kew) that he became acquainted with it through seed sent him from Farukhabad. Mr. H. St. George Tucker, Member of the Court of Directors of the East India Company observes that Lady Hastings grew it at Fatteghar, and Roger Hunt, in 1808, addressed the East India Company on the causes of deterioration of Pernambuco and Surinam Cottons. Thus we know that prior to Roxburgh's knowledge of it this plant had been experimentally tried in many parts of India."

"It is, therefore, perhaps not to be wondered at that this cotton has got considerably more widely distributed and is moreover more frequently met with in states of acclimatisation than is the case with any of the other New World cottons. Its large capsule, compact mass of seeds and the copius coating of floss naturally conveyed the impression of great value, and false expectations were raised, only to be rudely dispelled by comparisons of yield to acre. Gradually, however, all interest (or nearly so) in this particular Brazilian Cotton died out with the appearance first of the Upland Georgian Cottons, then the Mexican Cottons, and finally the Sea Island Cottons, all races that could be raised as annuals and occupy the soil for short periods. The present species in most countries accordingly fell into a state of complete neglect and either disappeared or survived as an

escape from cultivation and became "the wild tree cotton" of most popular writers, the properties of which have been the will-o'-the-wisp of nearly each decade for the past century in the world's cotton areas."

The Garo Hill or Assam Indigenous Cotton (*Gossypium arboreum var : assamica*) is another cotton concerning which information has been sought and the following account of it taken from "The Wild and Cultivated Cotton Plants of the World" by Sir George Watt, may be of interest.

"The people of the Garo Hills produce a peculiar kind of blanket, formed of rows of the tufted wool of this plant being placed by hand across the fabric and bound in that position by the weft forced home on each successive row of tufts. Whether that peculiar textile suggested the selection that has resulted in the production of the Garo Hill long-boll cotton it would, of course, be impossible to say. The floss, though abundant, is of little commercial value except, perhaps, to mix with wool."

There are many other types grown in the tropics, such as for example long-staple Upland types, which are far better and which may be worth cultivating.

Caravonica cotton grown from imported seed gave unsatisfactory results. Besides germinating badly, the plants raised were impure and the lint very inferior. If this cotton is given a further trial, seed of better quality must be obtained.

Market Prices of Cotton.

It may be of interest to give the relative values of different classes of cotton in Liverpool on 30th September 1922 :—

American Middling Upland	...	12.75 pence per lb.
Pernambuco Fair	...	12.52 „ „
Egyptian Sakel ...	...	17.25 „ „
West Indian Sea Island	...	23.00 „ „
„ „ Extra Fine		24 to 30 „ „

In Ceylon the short-staple Cambodia Cotton is said to have given satisfactory results and a local Cotton Spinning Company recently offered to buy the cotton at the rate of Rs. 20 per cwt. or 2⅝d. per lb.

Summary.

This article shows that long-staple cotton of good average quality can be grown in Malaya with a fair degree of success as compared with the average over a period of years in other cotton-growing countries, provided that its cultivation and the time of sowing are given adequate attention and that pest control is systematised. The best time for sowing the crop would vary in different parts of the Peninsula, calculations being based on the necessity of rain for germinating the seed and the advantages of dry weather during the picking period. The incidence of pests, more particularly the cotton-stainer,

depends somewhat on the presence of other host plants, "Kapok," "Roselle" and "Hibiscus," which would require to be destroyed or the pests found on them controlled in localities likely to be devoted to cotton.

The question of rainfall is not serious since our rains in the growing season are of the nature of showers, though a certain amount of boll-shedding usually results. The extent of this boll-shedding would differentiate between good, average and bad crops in the same way that rainfall effects rice and coconut crops. Experiments indicate that light well-drained loams of average water retaining capacity, well worked up, should give the best results and that steep and stiff land should be avoided. Cultivation must be intensive as opposed to present extensive methods and this point would probably decide the success or otherwise of planting cotton.

In the writers' opinion the eastern and northern states of the Peninsula offer the best prospects for cotton cultivation on account of their more defined wet and dry seasons and their lighter soils.

(Ref. D.A. 2088/22).

OIL FROM STERCULIA SPECIES.

By C. D. V. Georgi.

A sample of seeds, which were a species of Sterculia, was received recently from Kumbang Pasang Estate, Brunei, for examination.

Sterculia seeds are interesting from a chemical point of view, in that they contain two distinct oils, one in the pericarp the other in the kernel.

It was stated that the seeds are collected by the natives for oil expression, a sample of the native oil, which is used for edible purposes, accompanying the seeds.

Description of Seeds.

The seeds, which were rather mouldy on arrival, were ellipsoid in shape, about 1-1¼ inches long, ⅜-½ inch in diameter and pointed at both ends. They consisted of an outer skin, blackish in colour somewhat resembling the skin of a prune, covering a dark pulpy mass, which adhered to the husk of the kernel. The kernel consisted of a pale green endosperm, apparently consisting of a number of layers packed closely together.

Results of Examination.

The proportions of the various components and the results of their analysis were as follows :—

	per cent.
Proportion of skin and pulp ...	32.9
,, of inner husk	22.6
,, of kernel	44.5
Skin and Pulp.	
Moisture	13.4
Oil (Ether extract)	26.9
Residue (by difference) ...	59.7
Oil (calculated on dry pulp) ...	31.1
Nitrogen (dry oil free residue) ...	2.15
Kernel.	
Moisture	12.4
Oil (Ether extract)	28.9
Residue (by difference) ...	58.7
Oil (calculated on dry kernel) ...	33.0
Nitrogen (dry oil free residue) ...	1.40

Examination of Oil.

Portions of the skin and pulp, also of the kernels, were extracted with ether in order to obtain sufficient of the oils for the determination of the physical and chemical characteristics which are shown in the following table. The figures quoted in Lewkowitsch "Chemical Technology and Analysis of Oils, Fats and Waxes", Fourth Edition, Vol. II, Page 310 and in the Analyst, 1915, Vol. IX, Page 4 by Bolton and Jesson, for oils stated to be from *Sterculia foetida* are added for purposes of comparison.

TABLE SHOWING PHYSICAL AND CHEMICAL CHARACTERISTICS OF STERCULIA OIL.

	Pulp Oil.				Kernel Oil.		
	Extracted with Ether.	Native Expressed.	Figures from Lewkowitsch.[1]	Figures from Bolton and Jesson.	Extracted with Ether.	Figures from Lewkowitsch.	Figures from Bolton and Jesson.
Oil.	Semi-solid (30°C) dark brown, earthy smell.	Yellow liquid, sweetish smell.	...	...	Dark green fat[2], melting about 35°C, sweetish smell.	...	...
Density at 100°C (Water at 15.5°C=1).	.8560	.8614	...	...	.8676	...	...
Refractive Index at 40°C	1.4578	1.4668	...	1.4680[3]	1.4620	...	1.4658[3]
Saponification value ...	191.2	194.6	192.8	...	180.2	173.4	193.8
Iodine value (Wijs) ...	69.7	70.7	58.7	66.3	62.3	81.4	75.8
Acidity (Oleic acid per cent).	74.2	9.0	...	...	10.6	...	...
Unsaponifiable matter (per cent.)	3.7	0.9	...	...	5.6	...	...
Fatty Acids.							
Solidifying point (Titer value).	30-31°C	37°C	...	...	50.3°C	...	...
Iodine value (Wijs) ...	71.7	67.5	...	...	63.3	...	...
Mean Molecular weight...	298.9	289.5	...	...	325.2	...	...

1. Oil extracted with Petroleum Ether.
2. The dark green colour is undoubtedly due to the large quantity of green colouring matter present in the kernels.
3. In original paper in the Analyst the refractive index given in the Zeiss butyro-refractometer scale.

From these results it will be seen that the pulp oil is very acid and that the physical and chemical constants can scarcely be considered representative. The high acidity of the oil is undoubtedly due to the seeds having been packed while still moist. A noteworthy feature of the kernel oil is the high percentage of unsaponifiable matter amounting to 5.6 per cent.

Conclusions.

The results of this investigation show that both the pulp and kernels contain fair proportions of oil, but until greater quantities of the seed are available and representative samples of the oils are obtained, it is difficult to recommend them as useful for any specific purposes.

With regard to the extraction of the oils on a commercial scale it is certain however that the seeds, like African oil palm fruits, would have to be treated immediately after gathering, owing to their soft nature and the consequent liability of the oil to develop acidity. Further, on account of the small size of the seeds and the difficulty of separating satisfactorily the pericarp from the kernel, the husk of the latter being rather thin and fragile, it is thought that the most suitable method to adopt would be the expression of the whole oil, by pressing the seed whole, thereby obtaining a mixture of the pulp and kernel oils. From the results of the analysis it will be seen that the amount of mixed oils which could be thus obtained would be about 26 per cent, calculated on the dry seeds.

Although Sterculia trees are said to be distributed widely throughout the East Indies no information is available as to their growth, the period taken to come to maturity and whether the yield of seed is regular, so that their economic value is at present unknown.

ASH FROM CUTCH MANUFACTURE AS A FERTILISER.

By V. R. Greenstreet.

A sample of the ash from cutch manufacture was recently received from Brunei and analysed in order to determine its value as a fertiliser.

This substance is the residue of the bark of various mangrove trees after the extraction of the tannin (cutch) and the subsequent combustion of the exhausted material.

Description : The ash consisted of a fine white moist alkaline or caustic powder. It contained a few small lumps of carbonaceous and siliceous matter and 96.25 per cent passed through a sieve of 1 mm. mesh.

Results of examination : Analysis of the sifted portion gave the following results :—

	Original Ash Per cent.	Calculated on dried ash Per cent.
Potash (K_2O)	8.2	9.6
Phosphoric Acid (P_2O_5) ...	Nil	Nil
Carbon dioxide (CO_2) ...	10.4	4.2
Lime (CaO)	43.2	50.5
Insoluble Silica (SiO_2) ...	1.7	2.0
Iron and Aluminium oxides (Fe_2O_3. Al_2O_3)	6.4	7.5
Magnesia (MgO) ...	0.6	0.7
Sulphuric Acid (SO_3) ...	1.7	2.0
Hygroscopic moisture ...	14.4	—
Combined Water and Organic matter	15.7	18.3

Remarks and Conclusions :—The figures given in the above table show that the ash consists principally of lime and potash in the form of carbonate and hydroxide. Its value as a fertiliser is therefore about half that of quick-lime plus one sixth that of commercial potassium sulphate. The current prices of lime and commercial potassium sulphate are $16 to $18 and $285 per ton respectively and on this basis the total value of the material as a lime and potash fertiliser is about $56 per ton.

Whether it would be profitable to export the ash depends on freight and other charges for handling and packing. It might be remunerative to extract with water (lixiviate) and so prepare a concentrate on which the proportion of freight charges would be correspondingly diminished. This would require evaporating pans. Evaporation may be carried out either by exposing the liquor to the sun or by utilising waste heat from the cutch boiler. The ash should be stored in a dry place to prevent deterioration.

Any enquiries regarding this material should be addressed to the Secretary for Agriculture S.S. & F.M.S. (Ref. D.A. 192 22).

REPORT ON THE WORK OF THE INSPECTION STAFF, JULY TO SEPTEMBER, 1922.

By F. W. South.

Staff.

DURING the first week of August Mr. A. G. G. Ellis, Inspector of Agriculture, Johore, went on vacation leave to Europe and Mr. A. E. C. Doseas, Assistant Agricultural Inspector, Negri Sembilan was seconded to act for him. Mr. W. H. Barnes, Special Field Officer, Kuala Pilah, was appointed to act as Assistant Agricultural Inspector, Negri Sembilan.

Estate Visits.

During the quarter one hundred and thirty visits were paid to estates by the Chief Agricultural Inspector and Assistant Agricultural Inspectors throughout the Peninsula.

Diseases and Pests of Rubber.

Pink Disease (*Corticium salmonicolor*) has been newly reported from one estate in Perak South, and two in Negri Sembilan.

Dry weather which was fairly general during this quarter did much to check this disease in all districts. Routine treatment continued and the situation calls for little comment. Two estates in Perak North were given advice regarding more effective treatment of this disease and followed it with satisfactory results. In Ulu Selangor district a big demonstration of the methods of treating the disease was organised among Asiatic small-holders by the Malay Probationer. There were present 39 Malays including penghulus, and 22 Chinese. It is intended to organise other demonstrations on the same lines in different mukims to maintain attention to the treatment of the disease.

Mouldy Rot. (*Sphaeronema* sp.).—This disease was newly reported on five estates in Negri Sembilan and one estate in Johore.

In Negri Sembilan the position calls for little comment. Routine control work has continued steadily and the disease has as usual been less or more in evidence according as the weather has been dry or wet.

The disease still occurs regularly at Mentakab in Pahang, but there also it is receiving regular treatment.

In Malacca two new areas became infected during September, namely Sungei Rambai and Selatu. The latter mukim comprises rubber holdings mainly, from 2 acres to as large as 100 acres in extent, and owned mostly by Chinese.

Sungei Rambai is on the Johore boundary. The infected area extends along the Merlimau-Muar Road from the 18th mile to the Kuala Kesang river and penetrates inland for two or three miles. The disease certainly entered from Johore where it has been established for some years. Energetic action is being taken to get these outbreaks under control and to ensure that the disease is properly treated.

The disease reappeared in the wet weather on the estate previously infected between Tampin and Alor Gajah, but is receiving careful treatment.

In Johore, Mouldy Rot was active in Muar, Batu Pahat and Johore Bahru districts. The worst area is the coastal strip from Muar to Batu Pahat. The conditions on the holdings throughout this area are very insanitary and generally bad, so that they are very favourable to the disease. Effective treatment and control are almost impossible in the conditions prevailing and poverty prevents much action from being taken to improve them.

Fomes lignosus.—It was stated in a previous report that investigations by the Assistant Agricultural Inspector, Perak North, showed that a heavy cover of *Centrosema plumieri* provided conditions favourable to the rapid spread of *Fomes lignosus*. Further investigations are now in progress to determine if in these conditions of surface moisture fructifications of the fungus develop after a short period from all, or the great majority of the infected jungle stumps. If it should prove to be the case that fructifications are formed, then a search for such fructifications would appear to provide a ready means of ascertaining definitely the centres of infection and of effectively controlling the disease by dealing with these. The idea is that the fructifications may appear on the jungle stumps before the disease has spread far or been able to do much harm. The examination of stumps to determine if they are infected has proved to be practicable at a reasonable cost.

No other rubber diseases call for special comment.

Coconut Diseases and Pests.

Beetles.—The routine work for control of the Black Beetle and the Red Stripe weevil has continued satisfactorily in all infected areas.

Investigations by the Assistant Agricultural Inspector, Perak North, at Kota near Taiping again proved the harmful effect of insufficiently buried coconut trunks which come to the surface again as the result of wash.

The Assistant Agricultural Inspector, Selangor, visited a Malay holding some acres in extent at Kapar during September, and discovered that beetles were breeding at the base of practically every tree on 5 acres of the holding. It was estimated that there were at least 200 breeding grounds and over 4,500 grubs were destroyed. The trees had been burnt at the base to bring them into bearing

quickly, and the ash left after the fuel, probably coconut refuse, had been apparently completely burnt and had been heaped up round the trees in order to support and protect the adventitious roots. This discovery may prove of some importance, as these heaps—consisting of very finely powdered ash, with no sign of decaying matter—were absolutely unsuspected by the Malay Inspecting Officer in charge of the district. So far, however, no similar holding has been reported elsewhere in Selangor.

At Jeram Black Beetles were found breeding in Nipa rubbish left by Malays who had been cutting attaps.

In Johore both beetles are prevalent along the west coastal region which is largely cultivated for copra and where there are numberous dead coconut trees, stumps and timber. Destruction of coconut and arecanut palms is common and it is proposed to introduce an Enactment for the preservation of these valuable crops.

"*Manila Beetles.*"—Specimens under this name were forwarded from an estate in Kuala Langat district. The Government Entomologist identified them as *Diocalandra frumenti* a weevil affecting dead tissue only.

Unidentified Disease.—On an estate in Perak North newly opened with dwarf coconuts a fair percentage of the nuts died off after apparently germinating normally. Many of the seedlings had developed a good root system which appeared to be in good condition after the death of the shoot. The Mycologist is investigating the cause of this trouble.

Locusts.—A certain amount of damage is being done to coconuts on the same estate by a species of locust or grass-hopper which appears to be the same as that which attacked padi at Sitiawan in October 1921. Hand picking at night off tree stumps is being adopted as a control measure, as this was found to be effective at Sitiawan.

Pests and Diseases of Padi.

Nymphula depunctalis.—This pest, which did considerable damage last padi season to the bendangs at Matang Road is again very much in evidence. It is also present in bendangs at the 14th mile Batu Kurau road. Both localities are in north Perak. It is also recorded on nurseries at Permatang To Jaya in Province Wellesley. At Matang it was first found breeding on grasses which overhang and grow in the irrigation canals running through the bendangs. An attempt is being made to clear the grass from all canals in the vicinity. For dealing with the pest in the nurseries spraying is being carried out with a decoction of tuba root. A spraying demonstration was given.

Mole crickets. (*Gryllotalpa sp.*) These are doing harm to the bendangs at Bandar in south Perak. The area in question is dry and this is the reason for the attack which is expected to disappear when

rain comes. An effective method of control under dry conditions has not yet been worked out.

Other Pests.—Parnara sp., *Spodoptera pecten* and grasshoppers are recorded from Province Wellesley; *Parnara mathias* from Perak North; and "bena kura" (*Podops coarctata*) from Perak South. These insects have done but little damage.

Rats.—These have as usual been common generally. The Malay cultivators appear to appreciate the barium carbonate which, as stated in my last report, is being distributed at cost price through the agency of District Officers.

Lalang and Blukar.

There is nothing of importance to report under this head.

Water Hyacinth.

The Water Hyacinth gang in Perak North during the first half of June made the usual periodic clearing of certain small portions of State land in the vicinity of Taiping. On 19th June it proceeded to the Sungei Perak where it cleaned up the weed from Kuala Kangsar down to Ayer Mati in the mukim of Bota. It returned to Krian on 30th August. During September the gang was engaged on the Sungei Briah near Alor Pongsu.

In Perak South a tributary of the Perak river was cleared and small patches around Telok Anson were removed. In the coming quarter the Perak river is to be cleared, southward from Bota and also State land around Kampar.

A few small patches were destroyed in Selangor and work has continued steadily with satisfactory results in Negri Sembilan.

Pests and Diseases of Other Crops.

Giant Snails (*Achatian fulica*). The Assistant Agricultural Inspector, Penang and Province Wellesley reports that this pest has undoubtedly decreased in numbers during the quarter. It would appear that its rate of spread is very much less rapid in Province Wellesley than it was found to be in Ceylon. This is possibly due to unsuitable conditions, as the soil at Butterworth is almost pure sand and this undoubtedly forms a strong barrier to the progress of this creature. In Ceylon it was found that wood ashes and sawdust when placed in shallow ditches surrounding plots in vegetable gardens formed an efficient barrier to the passage of these snails.

The presence of the snails has not yet been reported from any new district, nor have they been observed to do any important damage except in European flower gardens. No natural enemies have been observed.

Citrus Pest.—An unidentified fulgorid bug was found in some citrus trees on an Estate in Perak North. A spray was recommended.

Specimens were sent to the Entomologist who stated that the insect had been recorded on candle-nut trees (*Aleurites triloba*) and had been sent to England for identification.

African Oil Palm.—Bud rot has attacked a certain number of trees on an estate in Selangor.

Rats have been very troublesome on the same estate. They appear to be attracted by the strong aniseed smell of the flowers. They live in the palms and eat the fruit at all stages, preferring it to other foods.

Caterpillars of the family Psychidae defoliated Mango, Coconut, Banana and Jambu Mawar plants in a small plot at Batu Gajah.

White Fly is recorded on custard apples on an estate in Perak South.

Mango Stem Borer, Rhytidodera simulans. The larvae of this beetle damaged Mango and Durian trees at Ipoh. All infected branches are being cut out and burnt. The soil round the trees has been thoroughly changkolled and a heavy dressing of manure has been applied.

Grasshoppers, damaged various annual crops on two estates in Pahang. On one estate they were successfully poisoned but this was not practicable on the small holdings adjoining the other estate.

Loranthus sp., etc. Mistletoe is very common on various fruit trees all over Negri Sembilan. Action is being taken to have it removed.

THE AGRICULTURAL POSSIBILITIES OF CAMERON'S HIGHLANDS, PAHANG.

By W. N. Sands.

IN Malaya for several years past the desirability of endeavouring to find areas of land suitable for the extensive production of quinine, tea, and other crops requiring a high altitude, in the trôpics, for their successful cultivation has been recognised by Government and the Department of Agriculture. Numerous localities have been suggested for this purpose from time to time, but none appeared to offer as much scope for exploitation as that imperfectly known tract of land in Pahang popularly termed Cameron's Plateau. This area was originally discovered by Mr. William Cameron, Government Surveyor, in 1885. Cameron reported that it was central hill-country, a sort of vortex in the mountains where over a wide area there were gentle slopes and 'pamah' (plateau) land with rounded hills shut in on all sides by loftier ranges. The mean elevation of the vortex he said was 4,500 to 4,750 feet above sea-level by aneroid.

Mr. H. N. Ridley, F.R.S., late Director of the Botanical Gardens, Singapore, visited the upper Bertam district in 1908 and studied the flora of it, but he did not proceed further than Gunong Berembun. On the other hand, Mr. H. C. Robinson and Mr. C. Boden Kloss with whom he travelled proceeded to Gunong Irau and traversed a portion of the Highlands on their way to and from that mountain. Ridley in his account of the flora of the Telom and Batang Padang valleys (Journal, of the Federated Malay States Museums, Vol. IV, No. 1, Dec. 1909) states that at the Telom (Lubok Tamang) camp and further on towards Gunong Berembun there are patches of perfectly flat ground, low-lying and muddy. These are of some size, and rather to the north of Gunong Berembun lies a similar flat area, apparently much more extensive, which is presumably the plateau described many years ago by Cameron and known by his name.

During March 1914, Mr. M. Barrowcliff, Assistant Agricultural Chemist, Department of Agriculture, Federated Malay States, explored a portion of the Bertam valley from the Sungei Ringlet to the foot of Gunong Berembun. He made the elevation of the area 3,400 feet by aneroid. His account of this visit was submitted to the late Director of Agriculture on 20th April, 1914, under the title "Report on a Visit to Cameron's Plateau." As will be shown later, the area reported on is not that described by Cameron, but the Lubok Tamang district mentioned by Ridley.

It was with the object of locating and examining the larger highland area that Government directed Mr. H. C. Robinson, Director of Museums, Federated Malay States, to organise an expedition to it. The writer accompanied the party in order to study the agricultural possibilities of the land.

The expedition left Tapah on 19th August and arrived at Jor (1,800 feet) twenty miles distant, the same day. From Jor to Lubok Tamang on the Bertam (3,500 feet) the distance is about 15 miles; this journey was made the next day. The track from Jor leads to the Perak-Pahang divide and crosses it at 4,200 feet. The land to this point is in the Batang Padang district; it is for the most part too steep for profitable cultivation although in various places it is used by the local Sakai as 'ladang' (provision grounds). Beyond the divide, and at elevations of 3,900 down to 3,500 feet along the road trace, there are patches of sloping land which might be used for agricultural purposes provided a road to the Highlands beyond gave access to them. The soil appears to be good and of similar composition to that at Lubok Tamang which will be fully described later, but the situation of the land is not as good as it is closely shut in by high mountains. It is possible, however, that some of the lower land might be worth clearing and planting in connexion with, and as an adjunct to, the Lubok Tamang area. All the land is under high trees, the undergrowth of which is not heavy.

Lubok Tamang District.

This section of the upper Sungei Bertam valley through which the river runs in approximately a north to south direction has been incorrectly termed the Telom, the name of a river about 12 miles to the north, and by others Cameron's Plateau. The area may be said to extend from the mouth of the Sungei Ringlet, a tributary of the Sungei Bertam, to the base of the Robinson Falls at the foot of Gunong Berembun, a distance of nearly 4 miles in a northerly direction with a mean elevation of about 3,500 feet. The main road to Cameron's Highlands would probably run through the whole length of this district from the upper or northern end of which the Highlands are only about a mile away in a direct line, although over a thousand feet higher in elevation.

Several days were spent in the neighbourhood of Lubok Tamang Camp (3,500 feet) and the Sungei Tiga camp at the foot of Gunong Berembun (3,700 feet) about 3 miles up-stream. The whole area may be described as a long narrow river-valley flanked by high hills. The land is covered with fairly heavy jungle almost to the summits of the hills. The undergrowth is thin, with *Pinanga*, *Areca* and *Calamus* palms predominating. In a few places there are Sakai 'ladang' but as the area is very sparsely populated, these are not extensive in size. On one or both sides of the river there are level or gently sloping stretches of land often ¼ to ½ mile in width with good light sandy soil and plenty of humus. In a survey of these made by the late Mr. Hemmy, the total area is shown to be 320 acres. It is possible however, that by terracing certain of the steeper slopes another 200 acres or more might be cultivated. The subsoil is porous so that drainage is satisfactory. In the Sakai 'ladang' a large variety of Annual and Herbaceous plants establish themselves once the forest trees are removed, and this again points to a fertile soil.

The growth of epiphytes such as orchids, ferns and mosses on the tree trunks indicates a humid climate with not necessarily a very

heavy, but rather an abundant and well-distributed rainfall. In the Sakai clearings the humidity of the atmosphere is decreased considerably as a result of letting in sunlight and air; this is in striking contrast to the humid condition of adjoining areas under forest. It may be expected from the central and sheltered position of these lands that the precipitation will be less than 200 inches per annum.

Barrowcliff, when inspecting the land, had in mind the possibility of growing tea, and he gives the following annual rainfall records of some of the tea centres in Northern India.

Assam	—Dibrugarh	...	112.11 inches.
Burma valley	—Sylhet	...	156.64 „
Duars	—Buxa	...	208.61 „
Darjeeling	—Hursoong	...	160.65 „

In Java the yearly rainfall of the best tea estates ranges from 100 to 220 inches.

The rocks from which the soil is derived consist of granite schists and slates, and as indicated above, the soil is light and rich and the sub-soil porous.

Barrowcliff's analyses of soil taken from a hillside at the upper end of the valley (analysis 1), and from flat and slightly undulating land (analyses 2 and 3) lower down are as under:—

Mechanical Analysis.

		1.	2.	3.
Gravel coarse sand	...	18.2	6.1	35.1
Fine sand	...	25.9	39.4	35.4
Silt	...	19.8	37.2	16.7
Fine silt	...	11.5	6.5	7.1
Clay	...	10.2	6.0	3.7
Humus	...	8.4	4.0	2.0

Chemical Analysis.

		1.	2.	3.
Moisture	...	7.5	4.9	1.85
Organic matter	...	33.7	12.6	9.7
Potash	...	0.145	0.190	0.345
Phosphate	...	0.065	0.063	0.061
Lime	...	0.10	0.04	0.04
Magnesia	...	0.045	0.10	0.02
Nitrogen	...	0.42	0.20	0.154
"Available" Potash	...	0.0177	0.0136	0.0156
"Available" Phosphate		0.0087	0.0109	0.0074

The conclusion Barrowcliff arrived at after discussing and comparing these analyses with some of those of the best tea soils in North-east India was, that they conformed in every respect to the requirements of a good tea soil and that there was no reason apparent why tea of high quality should not be produced. The writer's observations on the characters of the vegetation and soil, together with the further analyses reported on by Mr. V. R. Greenstreet, Assistant Agricultural Chemist, Department of Agriculture, on pages 281-282 support the opinion expressed above.

Although the Lubok Tamang area is relatively small, yet it is well sheltered and possesses a fertile well-drained soil together with a moist climate. There is little likelihood of periods of drought occurring.

The district is quite suitable for tea and perhaps also coffee of the best Arabian and "robusta" types, but it would not be wise to plant coffee on a large scale until observations on trial cultures had been made. The best Arabian types are susceptible to the leaf-disease (*Hemileia vastatrix*) and the elevation might be rather too high for the more resistant "robusta," still *Coffea robusta* thrives fairly well in certain parts of Java at an elevation of 3,400 feet.

The altitude of the area is below the optimum required for *Cinchona Calisaya var*: *Ledgeriana*—the best quinine-producing species; this tree would be likely to thrive far better on the Highlands above the Robinson Falls. On the other hand, the land is excellent for market-garden produce of various kinds, such as Irish potatoes and other root crops, cabbages, peas and beans, strawberries and tomatoes, but the commercial success of most of these cultures would depend on rapid and cheap transport facilities to market towns.

Florist's flowers such as carnations, roses, hippeastrums, gladioli, tuberoses, dahlias, violets and many other choice annuals and perennials would also thrive here.

Quite noteworthy is the occurrence of several good pasture grasses, for instance, species of *Panicum* and *Paspalum*, and the readiness with which these, and others of known worth, could be established might render it possible to develop areas under fodder grasses to feed live-stock kept for dairy and other purposes.

Mention has been made of the large variety of plants which are to be found growing in the Sakai 'ladang': among those observed were:—tapioca, sweet-potatoes, yams, millets, Job's tears, maize, pumpkins, musk-ochro, raspberries (*Rubus glomeratus* and *R. rosaefolius*) together with weeds and grasses of many kinds. The robust and healthy growth of various species of the Ginger family (*SCITAMINAE*) in this locality shows that suitable conditions exist for cardamons (*Elettaria Cardamomum*), ginger (*Zingiber officinalis*) and other allied spice-producing plants.

Mountain tops on each side of Lubok Tamang Camp, 4,300 and 4,600 feet attitude respectively, were ascended. Heavy tree growth was encountered almost to the summits of these peaks. The conifers,

Dacrydium elatum and *Podocarpus cupressina* were noted here as scattered trees. At the summits and on exposed ridges, the soil is peaty and mossy, and hardy ferns, such as *Gleichenia spp.* and *Dipteris Horsfieldii*, *Nepenthes*, small-leaved *Vaccinums* and Myrtaceous trees form the bulk of the vegetation.

Near the Sungei Tiga Camp is Gunong Terbakar (4,750 feet). This mountain is a striking feature of the district as it is not covered for some considerable distance below its summit with high forest but with scrubby trees, ferns and many small-leaved plants. Ridley remarked (loc : cit) that the highest land he visited was much less xerophytic than is usual at such altitudes in the Peninsula and commented on the fact that he did not find the distinct Myrtaceous trees *Baeckea* and *Leptospermum* and the fern *Matonia*. On Gunong Terbakar these were abundant as well as two striking species of pitcher-plants (*Nepenthes spp* :).

On 28th August Gunong Berembun (6,050 feet) was ascended and from the top of this mountain the first view was obtained of a considerable area of flattish and gently sloping land below to the north and west and backed by high mountains. Gunong Berembun is heavily forested almost to its top, where large clumps of the pretty little bamboo (*Bambusa elegans*), striking species of *Aeschynanthus* and orchids occur.

Cameron's Highlands.

The next day the Highlands were found by following the track from the camp at the foot of the mountain up Gunong Berembun for 1,000 feet to a dividing ridge and then bearing off sharply to the west-north-west. In a distance of less than a mile from the divide, and a descent of about 200 feet only, the Bertam was again reached at 4,800 feet and a site for a camp selected on a flat area near the river named 'Tanah Rata.' The following day the expedition moved up to this place and the exploration of what certainly appeared to be Cameron's so called 'plateau' was commenced.

Messrs. Robinson and Scrivenor ascended to Tanah Rata along the Sungei Bertam by the direct route from the Sungei Tiga Camp and discovered the fine falls of that river which are of the "bridal veil" type with a drop of about 850 feet from the south-west edge of the Highlands to the northern end of the Lubok Tamang district in a distance of just over a mile. The importance of this waterfall from an agricultural standpoint may be considerable, should it be found practicable, as seems likely, to develop cheap electrical power from it for driving machinery, heating and lighting purposes.

At a short distance below the point where the track leaves the dividing ridge on Gunong Berembun to Tanah Rata on the Sungei Bertam, the land on each side for a distance of about half a mile is of easy slope, and a fair-sized area could be utilized for quinine and other crops. The soil is a light friable loam with plenty of humus and easily drained. It is rather shut in, however, owing to its nearness to Gunong Berembun and is not as open as the land at Tanah Rata and further on.

From Tanah Rata Camp (4,800 feet) a visit was paid to the head of the Robinson Falls, a short distance below and along the clear slow-running river where it was seen that the mountains closed in on the river at this point and their slopes were too steep for cultivation.

On 1st September, a hill to the West-South-West of Tanah Rata and quite near to the camp was climbed. The height of it was 5,100 feet, or 300 feet above the camp. From the top a fine view was obtained of nearly the whole of the valley land to the north and north-west, and extensive flat and gently sloping areas were observed. At the summit of this hill are large masses of different species of Rhododendron such as are rarely met with in this country. It was due to this feature that the hill was appropriately named Rhododendron Hill.

Practically the whole area of the Highlands is open valley land with rounded hills 200 to 300 feet high dotted about. The mean elevation of the gently sloping and flat land is about 5,000 feet. The surrounding distant mountains are Gunong Berembun (6,050 feet), Batu Brinchang (6,660 feet), Irau (6,920 feet), Ruil (5,600 feet), Jasar (5,570 feet) with smaller peaks and high ridges connecting them. Cameron's description of the area is therefore quite correct, but by no stretch of the imagination can it be termed a 'plateau' so that it was agreed to substitute the term 'Highlands' as being a more suitable designation for it.

Leaving Tanah Rata Camp early on 2nd September, a tour of about 4 miles was made to the north-east to a point on the high ridge at 5,600 feet connecting Gunong Batu Brinchang and Gunong Berembun. This ridge forms part of the higher lands dividing the water-sheds of the Sungei Bertam and Sungei Telom. The land with the exception of exposed ridges is covered with tall straight-stemmed trees, among which are species of *Garcinia*, *Gordonia*, *Michelia*, *Saurauja*, *Pyrenaria*, *Quercus* (oak) and *Castanopsis* (chestnut). Conifers are few in number. The writer is not very familiar with the forest trees occurring at this altitude, but from the number of species seen it is likely that a study of them would prove of interest and certainly of value if it is found that good supplies of timber suitable for building and other purposes are available. Although the trees are for the most part of medium-size, still large specimens occur, for instance, an oak which was measured was found to be 12 feet 6 inches in circumference at 3 feet from the ground. From an agricultural point of view this association of many different species of trees of good clean growth affords evidence of a fertile soil and one likely to favour the growth of Cinchona and other hill crops.

Under the trees grow small *Pinanga*, *Areca*, and 'rotan' (*Calamus*) palms, the latter making walking progress difficult on account of their long spiny stems and leaves. Here and there are small open spaces in which the following striking species were noted, the large Lanana (*Musa Lanceata*), two ornamental large-flowered begonias, the terrestial orchids, *Calanthe angustifolia* and its yellow variety, a blue salvia (*Scutellaria discolor*), *Smeridas*, the beautiful yellow balsam (*Impatiens scarlatodes*) and the Himalayan violet (*Viola serpens*). Ferns, mosses and lichens are fairly abundant on the tree-stems, but epiphytic orchids

are far fewer, and in less variety, than in the Lubok Tamang district. In places where dead trees had fallen the curious parasitic plants, *Balanophora spp.* were observed. These leafless flowering plants, of which at least three species were seen, attach themselves to roots of forest trees and large lianes, and obtain all their food from their host-plants. The tuberous orange and red-coloured rhizomes of the parasites are of large size and very conspicuous on the ground. It is probable that they are capable of destroying forest trees under local conditions; still they could no doubt be readily eradicated and prevented from damaging estate cultures. Little is known at present concerning their life history and favourite host-plants.

On the journey large stretches of flat and gently sloping land were traversed. The soil which is covered with 3 to 4 inches of humus is for the most part light and derived from granite and quartz. The subsoil generally is porous so that after heavy rain the soil-water readily drains off. In some of the flat low-lying spots the soil is peaty on the surface, but this could be readily improved by drainage.

From Salvia camp 3 miles to the north of Tanah Rata, and just beyond the largest 'pamah,' further examinations were made of sloping and flat areas. A hill to the north-west of this camp, elevation 5,325 feet named Myrtle Hill afforded a magnificent panorama of the south and west portions of these. A portion of this valley land was crossed to a large tributary of the Sungei Bertam which drains the slopes of Gunong Jasar and Gunong Ruil. The higher ridges are mossy with malformed trees, the soil, also, is often covered with a thick layer of fibrous peat with rock below. The gnarled appearance of the trees on the exposed ridges and peaks is no doubt due to the wind combined with unfavourable soil. Lower down on the sloping lands the character of the vegetation and soil is similar to that described previously in other parts of the Highlands. On all sides there are large areas capable of being successfully cultivated. Small areas were noted with an undue proportion of organic matter in the soil, and others with a fine silt as surface soil, but where the subsoil is porous, as is usually the case, these unfavourable conditions could be readily improved by cultivation and drainage.

Messrs. Robinson and Scrivenor who ascended Batu Brinchang (6,660 feet) 3 miles to the north of Salvia camp reported that they passed through, en route, further areas of flat land of an average height of 5,150 feet with good soil and tree growth.

Several soil samples were taken for analysis by the Agricultural Chemist of the Department of Agriculture. The results of the examination of these will be found on pages 281-282 of this Journal. As anticipated they indicate a fertile soil with good physical and chemical characters.

As a result of this preliminary examination of these Highlands which are estimated to have an area of at least 16 square miles, the opinion is expressed that no difficulty would be found in selecting 2,000 acres of gently sloping land for crops such as quinine and tea. The elevation of all the land would be between 4,800 and 5,200 feet.

The extensive river-flats estimated at not less 1,000 acres are not included in this figuree, but portions of these not required for residential purposes might also be used. Further some of the steeper lands could be successfully cultivated. The area has not been surveyed so that it is not possible to give more than the above rough estimate of the cultivable land available.

Judging from the character of the vegetation the rainfall and humidity are high, but in the absence of meteorological records it is most difficult to form a reliable estimate of the former. The whole district is so well sheltered aud protected on all sides by high mountains to a considerable depth that the heaviest rains brought by the south-west and north-east monsoons are no doubt precipitated on the western and eastern slopes of the Central Range, and do not frequently reach these Highlands. As suggested in connexion with the Lubok Tamang district, the annual rainfall may be abundant, but not necessarily unduly excessive for hill-cultures such as either Cinchona or tea both of which will thrive in places where the annual precipitation exceeds 200 inches per annum, provided it is well distributed and the soil is satisfactory. The humidity is certainly high at the present time still this would be reduced considerably as the result of extensive clearings.

The climate is cool; from data obtained from Gunong Tahan by the Director of Museums, the maximum day temperature will probably not exceed 75°F and the night temperature 54°F. A mean annual temperature of 64°F is indicated. These temperature ranges are similar to those of highland districts in Java where excellent yields of quinine, tea and market-garden produce are obtained. Frost is not likely to occur at any season.

The expedition left Cameron's Highlands on 7th September and reached Tapah via Lubok Tamang and Jor on 11th September.

General Summary.

The agricultural possibilities of the Lubok Tamang and Cameron's Highland districts in the north-western corner of the State of Pahang and comprising the uppermost valleys of the Sungei Bertam and its tributaries are reported on. Information concerning the botanical features, soils and climate of the areas is also included.

Lubok Tamang.

Situation.

This district extends in approximately a south to north direction from the Sungei Ringlet, a tributary of the Sungei Bertam, to the Robinson Falls at the foot of Gunong Berembun. The length of it is about 4 miles and the mean elevation 3,500 feet.

An account of this area is given because the main road to Cameron's Highlands would probably traverse the whole length of it, and it could be readily developed in connexion with the opening up of the larger area

Lubok Tamang is about 36 miles distant from Tapah and 24 miles from the completed section of the road from that town.

Area Suitable for Cultivation.

The district may be described as a long narrow river valley well-sheltered by high hills. It has been surveyed in detail and shown to contain 320 acres of river-flats and gently sloping lands. Further areas, however, could be made available by terracing steeper land and including portions of land along the lower portion of the road trace from the Perak-Pahang divide. Little difficulty should be found in procuring 500 acres or more of cultivable land.

Soil and Climate.

The surface soil is light with plenty of humus. The subsoil is porous and drains well. The physical and chemical composition of the soil are good and equal those of some of the best tea soils of India and Java.

The climate is cool and humid. The rainfall is no doubt high, but in the absence of records the annual amount and its distribution throughout the year cannot be closely estimated. It is unlikely that the rainfall exceeds 200 inches per annum. No periods of drought need be anticipated.

Crops and Live-Stock.

The area appears to be eminently suitable for tea and market-garden produce, whilst the possibility of growing coffee of the best Arabian and 'robusta' types on a small scale should not be lost sight of. Further details of the crops which may be cultivated are given in previous pages. It is believed that good pasture grasses suitable for live-stock could be readily run. Live-stock for draft, transport and dairy purposes would be most valuable in these mountain districts. In the highland districts of Java, the small pack-horse is extensively employed for the transport of supplies and produce over long distances.

Poultry of various kinds may be expected to thrive here. Fowls are already reared successfully by the Sakai.

An abundant supply of excellent clear river-water is available at all seasons of the year.

In regards to supplies of poultry, milk and vegetables, the district should be self-supporting with the possibility of an exportable surplus of vegetables if rapid and cheap transport facilities to the chief market towns became available.

Labour and Transport.

There are no residents except a few Sakai; these might perhaps be supplemented by others from the upper Batang Padang district and employed in felling and clearing jungle. It would be unwise, however, to reply on these people who would only desire to work, if at all, at

irregular intervals. Practically all the labour required, therefore, would have to be imported. Chinese working under contract might prove useful at the outset, still in the long run Javanese or Indians from mountainous districts in their own countries where Cinchona and Tea are grown would be more suitable in that they would possess knowledge of the work with these and other hill-cultures and more readily adapt themselves to local conditions.

Cameron's Highlands.

Situation.

This area which is situated in the north-western corner of Pahang was originally discoved by Mr. William Cameron, Government Surveyor, in 1885, and comprises 16 square miles or more of open valley land. It is about 41 miles distant from Tapah along the route followed by the expedition. The district is well-sheltered by high mountains from the slopes of which the Sungei Bertam has its source. It is only about a mile away in a direct line from the northern end of the Lubok Tamang area, although over 1,000 feet higher in elevation. It contains large tracts of flat and gently undulating land suitable for cultivation, the elevation of which ranges between 4,800 and 5,200 feet. The configuration of this 'vortex in the mountains' resembles, although on a smaller scale, the famous Pengalengan Highlands of Java where such fine crops of Cinchona and Tea are produced.

Area suitable for Cultivation.

As no topographical survey has been made and only a preliminary investigation of the land was possible, it is difficult to estimate the acreage available for cultivation. It is judged, however, that there are at least 2,000 acres of gently undulating land and 1,000 acres of river-flats which could be utilized, besides, it is reasonable to suppose that additional areas of some of the steeper hill-sides could be terraced and planted. In Java under similar conditions much use is successfully made of steep lands.

Soil and Climate.

The soil which is derived from granitic rocks is for the most part light and friable, with plenty of humus and porous sub-soil. No swamp land with permanent surface-water was seen. Small areas with peaty soil were observed, but these were usually on exposed ridges. On one of the flat areas the top-soil was a rich loam over a sandy substratum. As with the Lubok Tamang soils the analyses of samples taken show good physical and chemical qualities. Most of the area, even where low-lying, should drain readily and prove particularly fertile under plantation conditions.

The growth of trees with which the land is completely covered is good and varied. The undergrowth, as is to be expected, is thin owing to the dense overhead shade and the high elevation.

The climate is cool and moist, but it is most difficult to judge, accurately, the range of temperature and average humidity. From the Gunong Tahan records a minimum temperature of 54°F and a

maximum of 75°F with a mean annual temperature of about 61° is indicated. The humidity under the present forest conditions is probably 86%; this of course would decrease considerably when extensive clearings were made.

The rainfall is abundant but not necessarily excessive. Although there are no data available it is not expected, owing to the central and sheltered position of the area, that the early precipitation will exceed 200 inches. The annual rainfull of certain well known Cinchona and tea districts in Java and India ranges from 110 to 230 inches.

The Sungei Bertam and its small tributaries provide an abundant and perennial supply of clear, cool water within easy reach at most points.

Crops.

Cinchona is the crop indicated for this locality. The sloping land alone of these Highlands is believed to be capable of producing, at the 5th year's harvest, dry bark, or crude alkaloid, containing more than three times the quantity of quinine, calculated as quinine sulphate, used annually in this country. It is highly desirable that the requirements of Malaya in respect of quinine, which are estimated at 20,000 lbs. per annum, should be met locally. Very large sums of money are sent out of the country every year to purchase essential quinine salts obtained from bark grown in foreign countries.

As a full account of the Cinchona Industry in Java has been recently published by the writer in the Malayan Agricultural Journal Vol. X, No. 3, 1922, and can be referred to, further details concerning the crop need not be given here. Sufficient it is to add that the conditions for the successful cultivation of Cinchona such as shelter, elevation, soil, temperature, rainfall, appear suitable and in many respects comparable with those of good Cinchona districts in Java.

Several of the remarks concerning tea, market-garden and other produce in the Lubok Tamang area would also apply to these Highlands, but the lower area appears more suitable for those crops. The writer is of opinion, however, that large supplies of food-stuffs could be produced here if necessary for the use of residents at a hill-station.

Labour and Transport.

The labour question is discussed in connexion with the Lubok Tamang district and the observations made apply to both areas. If is estimated that a labour force at the rate of $\frac{1}{4}$ to $\frac{1}{2}$ unit would be required for each acre opend up and planted.

In the event of Cinchona cultivation being undertaken at some future date, it should be stated that in the recent contract made in the Netherlands East Indies between the Cinchona growers and manufacturers, the latter will now accept crude alkaloid from the growers in the place of dry bark. In the writer's account of the Cinchona Industry in Java (loc ; cit) the following paragraph occurs " Some of the large producers consider that they could obtain better prices if they adopted a process devised locally under which it is possible to

extract crude quinine sulphate from wet-bark on estates. The process is not believed to be covered by patent rights, and as far as the writer is aware, it is not yet being worked, because the manufacturers of quinine compounds are not in favour of it. Still there is no doubt that if it could be successfully employed there would be a large saving in the drying, packing, transport and freight charges, all of which are paid by the growers. The freight and transport charges alone would only be about 7 to 8% of those now paid. The cost of manufacture would be far less than the total of the charges given above, especially if the production of this crude sulphate was carried on along co-operative lines." This process if adopted here would have an important bearing on the transport question for it would mean a considerable reduction in the bulk, weight and cost of transporting the produce of the plantations to railway or port.

The question of gaining access to the area by means of road is outside the scope of this article, but judging from the use made of transport animals in the mountainous districts of Java these might perhaps be successfully employed in this district, and if so, the difficulty of transporting supplies to the Highlands and the various products from them to railway or port would be considerably lessened, even if it is not possible for various reasons to complete in the near future the road originally planned and partly constructed, but only a bridal path.

Cost of Clearing and Planting.

The cost of clearing and planting this land at the present time with Cinchona and Tea under the conditions described cannot be estimated, but it may serve a useful purpose, if only as a basis on which to compute the cost, if the following information obtained in Java recently is given, because the rates of pay of coolies there, when converted into terms of Straits Dollars appeared to be similar to those now ruling in Malaya.

The cost of establishing a Cinchona plantation in the Preanger district of Java is from 75 to 106 dollars per acre for average land with an additional outlay for maintenance, supplying, weeding, etc., totalling $45 per acre at the end of three years, when the first small crop of bark may be reaped. Under the total cost are included nurseries, felling, clearing, cultivation, terracing, draining and planting.

Conclusion.

As a result of this preliminary examination of the Lubok Tamang district and Cameron's Highlands from an agricultural standpoint, the opinion is expressed that the areas are suitable for starting certain valuable industries, new to Malaya, under plantation conditions, and that there is every prospect of success attending any efforts that may be made along approved lines.

The cost of opening up a road to these Highlands may not be considered commensurate with the prospective value of the produce likely to be obtained from them, but should the district be found to fulfil the requirements of a large hill-station for residential purposes, then the whole aspect of the matter of cost would be changed, because there appears to be plenty of land available for bungalows, recreation grounds and gardens as well as plantation sites.

REPORT ON THE SOILS OF LUBOK TAMANG AND CAMERON'S HIGHLANDS.

By V. R. Greenstreet.

DURING the recent visit of the Assistant Economic Botanist to Lubok Tamang and Cameron's Highlands, the opportunity was taken of obtaining for analysis various samples of soils considered typical of those areas; the present article gives a short description and analysis of the samples taken.

Lubok Tamang Area.

No. 1—Soil from an abandoned Sakai ladang, half a mile south of Gunong Berembun and at an altitude of 3,600 feet. The land is flat and supports a rank growth of "blukar" 12 to 20 feet high. The soil and subsoil are sandy, covered with 2 inches of humus and are very characteristic of this area adjoining the Bertam River.

No. 2—Soil from virgin jungle, one mile south of Gunong Berembun and also at an altitude of 3,600 feet. The land is undulating and about 50 feet above the river. The soil is more loamy than No. 1, has a sandy subsoil and is covered with 2 inches of humus.

Cameron's Highlands.

Nos. 3 & 4—Soil from slightly undulating land under virgin jungle south-west of Myrtle Hill and at an altitude of 5,200 and 5,000 feet respectively. The soil is covered with 3 inches of humus and the subsoil is sandy and of unknown depth.

Nos. 5 & 6—Soil from the east bank of Bertam River under virgin jungle and at an altitude of 4,950 feet. *No. 5* is from undulating land, sandy, covered with 2 inches of humus and with a loose gravelly subsoil; *No. 6* is from flat land, is a loamy soil, with a sandy subsoil and covered with 3 inches of humus.

General Observations.

All the soils are of the light sandy type and range from gravels to rich sandy loams. They are all derived from the disintegration of granite and are dark-coloured soils, well supplied with plant nutrients. For such open soils the percentage of organic matter and nitrogen is extremely satisfactory. In view of the different altitude of Lubok Tamang and Cameron's Highlands it is convenient to deal with them separately; the former as a potential Tea area and the latter for Cinchona.

Lubok Tamang.

Chemical Analysis.

Number.	*1.*	*2.*
	per cent.	per cent.
Potash (K_2O)	.50	.50
Phosphoric acid (P_2O_5)	.10	.13
Nitrogen	.11	.48
Insoluble in mineral acid	90.1	55.6
Lime requirement in tons per acre (acidity) ...	$8\frac{3}{4}$	$8\frac{3}{4}$

Both soils contain a good supply of potash, phosphoric acid and nitrogen. *No. 1* has a very low acidity, is inclined to be gravelly but with regular and very constant rain there is no doubt of its fertility. *No. 2* has a high proportion of nitrogen and organic matter and may be described as a sandy loam. It is well drained and is a very fertile soil. The Mechanical Analysis may be compared with those of some of the best tea soils of Assam and Cachar.

Mechanical Analysis.

Description.	Lubok Tamang.		Dibrugarh. (Assam)		Cachar.	
	1.	*2.*	*a.*	*b.*	*a,*	*b.*
	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.
Gravel and sand	77.6	22.3	26.3	11.4	24.2	13.5
Fine sand ...	6.4	7.4	45.3	43.2	36.4	34.3
Silt ...	3.1	3.8	18.3	31.7	13.6	16.1
Fine silt ...	3.8	21.2	5.7	9.2	17.3	20.5
Clay ...	2.0	17.6	3.1	3.7	6.4	11.5
Organic matter (loss on ignition)	5.9	21.6	...	...	...	...
Moisture ...	1.1	4.2	1.3	0.9	2.2	4.0

The outstanding feature of the Indian tea soils is their porosity and in this respect the soils of Lubok Tamang show great similarity. *No. 1* being rather gravelly would give a smaller production than *No. 2* but would tend to produce tea of a higher quality.

The soils are also eminently suitable for market gardens. *No. 1* is light and sandy and is characteristically warm and dry, *No. 2* containing more clay and organic matter has a greater water-holding capacity. It would therefore produce larger crops of vegetables than *No. 1.*

CAMERON'S HIGHLANDS.

These four soils show a great similarity amongst themselves. They are light sandy loams containing on an average 60% of sand and gravel. There is a good supply of organic matter, nitrogen and potash ; the phosphoric acid is inclined to be low in *Nos. 3, 4 & 5* but there is no marked deficiency.

Chemical Analysis.

Number.	*3.*	*4.*	*5.*	*6*
	per cent.	per cent.	per cent.	per cent.
Potash (K_2O) ...	.53	.48	.55	.69
Phosphoric acid (P_2O_5) ...	.09	.06	.05	.10
Nitrogen ...	.21	.17	.17	.22
Insoluble in mineral acid ...	68.9	77.0	74.7	61.8
Lime requirement acidity (tons per acre) ...	$9\frac{3}{4}$	$5\frac{1}{4}$	$6\frac{3}{4}$	$7\frac{3}{4}$

Experience in Java has shown that efficient drainage is the *sine qua non* of successful cinchona planting. A hard water-logged subsoil tends to prevent root development. Comparison with Java soils shows that the mechanical composition of the soils of Cameron's Highlands leaves nothing to be desired.

Mechanical Analysis.

	Cameron's Highlands.				Pengalengan Highlands, Java.			
Number.	*3.*	*4.*	*5.*	*6.*	*a.*	*b.*	*c.*	*d.*
	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.
Gravel & sand...	48.0	51.3	59.7	8.0	31.5	28.3	21.4	27.6
Fine sand ...	9.9	11.0	6.2	35.9	43.3	26.8	48.7	44.1
Silt ...	2.2	3.3	2.1	13.6	10.2	14.1	19.5	20.0
Fine silt ...	10.4	15.4	10.4	18.8	6.3	6.3	3.3	4.2
Clay ...	6.0	6.2	7.9	3.3	9.4	9.0	4.0	3.3
Organic matter	17.2	9.5	11.5	15.7	...	...	...	...
Moisture ...	4.5	2.7	2.2	3.3	...	...	...	...

Summary.

Analysis of the soils of Lubok Tamang and Cameron's Highlands shows that they differ greatly from the majority of cultivated Malayan soils. They possess a uniformly open texture without the corresponding diminution in fertility that is so often the case. In addition to possessing a striking resemblance to the best tea and cinchona soils of India and Java, they have all the properties of good market garden soils.

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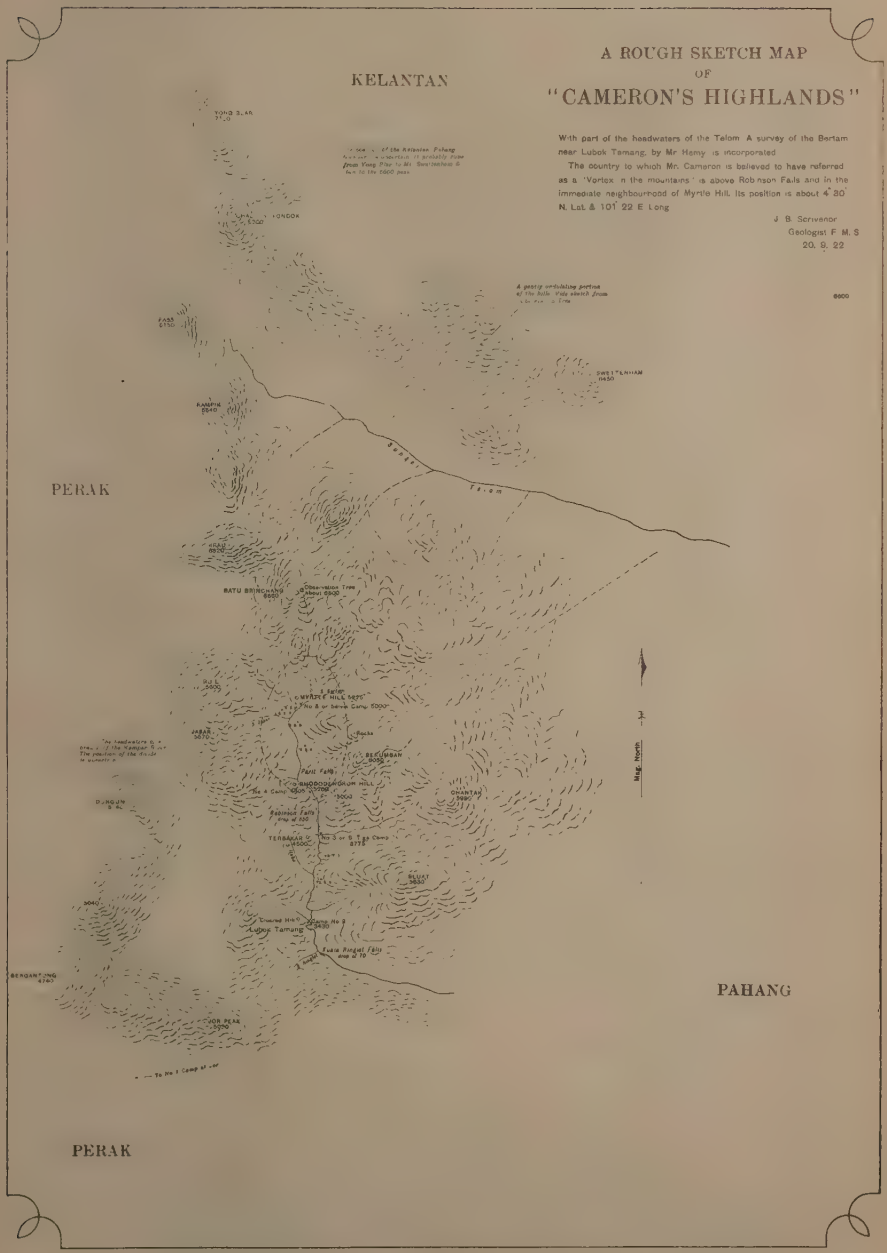
* The annexed sketch map which has been prepared by Mr. J. B. Scrivenor, Government Geologist, shows the situation of the different areas and places mentioned in this and the preceeding article and also the approximate positions of the spots where soil samples were taken.


A ROUGH SKETCH MAP
OF
"CAMERON'S HIGHLANDS"
With part of the headwaters of the Telom A survey of the Bertam near Lubok Tamang, by Mr Hemy is incorporated
The country to which Mr. Cameron is believed to have referred as a 'Vortex n the mountains' is above Robinson Falls and in the immediate neighbourhood of Myrtle Hill. Its position is about 4° 30' N. Lat & 101° 22 E Long
J B. Scrivenor
Geologist F M. S
20. 9. 22
KELANTAN
PERAK
PAHANG
PERAK
Telom
Bertam
Mag. North
MYRTLE HILL 4675'
BATU BRINCHANG
SWEETENHAM
RINGLET
TERBAKAR
BERJUNTAI
CHANTAN
RAMPIN
JASAR
PARI FALLS
ROBINSON FALLS
Lubok Tamang
Kuala Ringlet Falls
BENDANG LONG
JOR PEAK
DJINGUN
BELLAST
Observation Tree
About 6900'
No 3 or S. T. P. Camp
6775'
No 2 Camp
6500'
No 1 Camp
6000'
Camp No 2
5700'
Camp No 1
5500'
Rapids
Falls
Cascades
Waterfall
Bridle Path
Footpath
Track
Rivers
Streams
Contours
Boundaries
Camps
Peaks
Hills
Mountains
Roads
Paths
Tracks

KAPOK OIL.

By C. D. V. Georgi.

WITH reference to the article on Kapok in this Journal Vol. X, No. 2, February 1922 a series of experiments has been carried out recently with regard to the oil which can be extracted from the seed of this tree.

The results of the experiments which included the determination both of the oil content of the seed from different parts of the country and the characteristics of the oil were as follows :—

Oil Content.

The results of analysis of the different samples of seed are given in the following table :—

	Kuala Kangsar.	Lower Perak.	Krian.
Moisture	9.6	13.5	13.3
Oil (Chloroform extract)	22.1	18.6	16.8
Residue (By difference)	68.3	67.9	69.9
Nitrogen	3.33	3.44	3.28
Oil (Calculated on dry seed) ...	24.4	21.5	19.4
Nitrogen (Calculated on dry oil-free residue)	4.88	5.07	4.70

A portion of the seed from Kuala Kangsar was also decorticated as follows :—

	per cent
Proportion of husk	43.2
Proportion of kernel	56.8

The Oil content of the kernel, and the nitrogen content of the residue after extraction of the oil were also determined, the results obtained being given in the following table :—

	per cent
Moisture	3.2
Oil (Chloroform extract)	40.0
Residue (By difference)	56.8
Nitrogen (Dry oil-free residue)	10.39
Oil (Calculated on dry kernel)	41.3

Expression of Oil.

In connection with the preparation of the required sample of oil for the determination of the characteristics an experiment was carried

out to ascertain the percentage of oil which could be expressed from the seed using the small laboratory hand-press.

About 4 lbs of the seed from Kuala Kangsar were crushed between rollers, warmed and pressed, the whole operation being repeated and the residue in the press analysed.

The results were as follows :—

	per cent
Moisture	11.5
Oil (Chloroform extract)	9.0
Residue (By difference)	79.5
Nitrogen	3.08

Assuming therefore that the original seed had an oil content of 22 per cent, it will be seen that about 60 per cent of the oil has been expressed.

The oil was clear, pale yellow in colour, with a sweetish smell. It was noticed that on standing a small amount of "stearin" was deposited.

Characteristics of Oil.

The results of the determination of the characteristics of the oil were as follows (the figures for a previous sample of oil from Kuala Kangsar similarly expressed and exhibited at the Malaya-Borneo Exhibition, Singapore, and also those for Cottonseed oil being given for purposes of comparison) :—

	Present Sample Kuala Kangsar	Previous Sample Kuala Kangsar	Average figures for Cottonseed Oil.
Oil.			
Density (15.5°C) ...	.918	.918	.923
Refractive Index (20°C)	1.4710	1.4685	-
Saponification value ...	191.0	193.3	193
Iodine value (Wijs) ...	94.3	98.1	110
Acidity (Oleic acid per cent)	1.8	26.9	
Unsaponifiable (per cent)	0.8	1.1	0.9
Fatty Acids.			
Solidifying point (Titer value) ...	28.4°C	28.4°C	35°C
Mean molecular weight...	284.3	292.4	-
Iodine value (Wijs) ...	94.2	96.6	-

Results of Experiments.

These experiments show that Kapok seed constitutes a valuable bye-product, containing rather more than 20 per cent of oil which is easy of extraction.

The seeds are free from hairs and can therefore be decorticated easily if necessary, in which case the oil content of the kernel amounts to about 10 per cent.

It will be noticed from the analysis of the "previous sample" of oil from Kuala Kangsar, that Kapok oil tends to develop acidity, and care must therefore be taken to ensure that the seed is stored dry.

The cake remaining after the extraction of the oil is rich in albuminoids, 3.98 per cent of nitrogen corresponding to 24.9 per cent of albuminoids.

Possibilities of Kapok Oil.

Kapok oil which, as will be seen from the table above, is closely related to Cottonseed oil is used to a certain extent, more particularly in Holland, for edible and soap-making purposes.

It is not a well known oil however, though with the increased demand for the fibre, larger quantities of the seed will be available and, if it can be shipped regularly, its market should widen considerably, especially as the cake forms a valuable feeding stuff.

It is understood that efforts are being made in India to extend the export of Kapok seed for oil expression.* The Indian Kapok seed although derived from a different tree (*Bombax malabaricum*) from the local variety (*Eriodendron anfractuosum*) yields an oil which is similar in all its characteristics, except that its Iodine value is less.

The meal from the Indian seed is also of higher nutritive value containing about 36.5 per cent of albuminoids as against 27.3 per cent for the local variety.

* Compare Bulletin Imperial Institute Vol. XVIII, 1920, page 335.

NITROGEN LOSSES FROM DUNG AND URINE AND PREVENTION DURING STORAGE.

THE problem of the deterioration of cattle and horse manure under storage is of considerable importance especially now that motor power is being used more extensively in farming practice, involving a decrease in the natural manure available on the spot.

The following conclusions have been published in the Agricultural Journal of India Vol. XVII, No. 1, 1922, by N. V. Joshi as a result of his investigations carried out in India.

(1) The losses from cattle dung when stored either under aerobic or anaerobic conditions are small.

(2) In the storage of urine, large amounts of nitrogen are lost under aerobic conditions and negligible amounts under anaerobic conditions.

(3) If the urine is covered with a layer of oil, *e.g.* kerosene, mustard or coconut oil, anaerobic conditions prevail and the losses of nitrogen during storage are small.

(4) The addition of sulphuric acid, superphosphate or formalin, to urine is also effective in preventing loss of nitrogen but the cost is prohibitive in practice.

(5) If straw or soil is used as an absorbent of urine for purposes of storage large losses of nitrogen occur and these absorbents are therefore of no value.

(6) Greater losses occur in mixtures of cattle dung and urine than when these are stored separately.

Cattle dung and urine should therefore be stored separately and the latter in tanks under anaerobic conditions or in tanks in which the urine is covered with a layer of oil.

It should be understood that even under aerobic conditions the dung should be kept under cover to prevent leaching by rain.

B.J.E.

"WHOLE" RUBBER OR DESICCATED LATEX.

By B. J. Eaton.

THE interest in new types of raw rubber or new methods of preparation is overshadowed at the moment by that which is being taken in new uses for rubber and especially the direct application of liquid latex to the manufacture of paper, impregnation of fabrics, cords for tyres etc.

A new process of preparation of raw rubber however, which has been patented recently, is of considerable interest, although this type of rubber has been prepared by other methods some years ago and is known to be of excellent quality.

It has been known for some years that raw rubber containing all the constituents of latex possesses properties superior to those of ordinary sheet or crepe rubber, both in respect of rate of vulcanisation and tensile qualities.

In Bulletin No. 21 "The Preparation and Vulcanisation of Plantation Para Rubber", published by the Department of Agriculture in 1918, page 78 et. seq., results of tests on such rubber prepared by the evaporation of thin layers of latex in order to retain all the constituents of latex and at the same time to inhibit maturation, are described. It is also shown that this type of rubber has a high nitrogen content and a rapid rate of vulcanisation, whereas "slab" rubber has a low nitrogen content, due to decomposition of protein matter resulting in loss of nitrogen, together with a rapid rate of vulcanisation due to the formation of basic nitrogenous substances from the proteins, which act as vulcanisation accelerators.

It has also been shown in the same publication that the rapidity of cure of "whole" rubber containing all the constituents of the latex is due to vulcanisation accelerators normally present in the serum which are removed more or less completely in the preparation of sheet and crepe rubbers, due to washing and machining the fresh coagulum.

Another point of interest is that the amount of "rubber" prepared from latex by an evaporation or desiccation process is about 5 to 10 per cent greater than the weight of sheet or crepe rubber prepared from an equal volume of similar latex, due to the fact that the non-caoutchouc constituents of the latex are retained and will be included as "rubber" in the final product.

It is also probable that the presence of some or all of the non-caoutchouc constituents of the latex in the rubber improves not only the quality of the vulcanised product but also the keeping qualities of the raw product. This may be a direct or an indirect effect. The non-caoutchouc serum products are hygroscopic and probably absorb sufficient moisture in the final raw product to inhibit or reduce

oxidation processes, which are undoubtedly the cause of the deterioration of sheet and crepe rubber on storage in the presence of air. It is well known that raw rubber can be stored better in a moist atmosphere and our experiments (especially many unpublished data on storage of raw rubber) have shown that "slab" rubber containing from 10 to 20 per cent of moisture can be kept for a long period without deterioration, compared with dry sheet or crepe.

Smoke cured Latex.—It might be mentioned here that Fine Hard Para, Wickham smoke-cured and Derry smoke-cured rubber, which are somewhat similar in character, are essentially evaporated latex, although, as our experiments have shown, the smoking in these processes retards the rate of vulcanisation of the product and is in that respect undesirable.

Fine Hard Para and the imitation products made by the Wickham and Derry processes contain moisture and almost all the constituents of the latex. Wickham and Derry rubber usually contain a small amount of moisture depending on the conditions of treatment, whereas Fine Hard Para usually contains from 15—20 per cent of moisture.

Quality of "Whole" Rubber.—Apart from the uniformity of Fine Hard Para, in respect of rate of vulcanisation, which has in the past been one of the principal reasons for its preference by manufacturers, it is probable that other desirable qualities are conferred by the non-caoutchouc constituents *e.g.* behaviour of the raw rubber on the mixing and calendering rolls and its value in the preparation of solutions. It also appears to be indicated as more "fool proof" than ordinary sheet and crepe rubber during vulcanisation, which may be due to interaction between the non-caoutchouc constituents and the vulcanising agent—sulphur.

From this it may be reasonably argued that "whole" rubber prepared by the desiccation of latex, without the application of smoke, will possess even better qualities. This is shown in our earlier experiments as well as in recent results given by Hopkinson, the patentee of the new process.

The Kerbosch Process.—Reference might be made also to the Kerbosch process, which was proposed some years ago in Sumatra as a method of preparation of rubber.

This process is described in "Estate Rubber. Its preparation properties and testing" by de Vries (1920) page 436.

The process consists in the desiccation of undiluted latex by means of hot air on the interior surface of a horizontal drum. Another process which, as far as the writer recollects, (no reference can be found at the moment) was proposed by Schadt in The Netherlands East Indies, consists in the evaporation of latex in thin films contained in large shallow trays by means of direct sun heat.

One of the principal reasons why such processes for desiccating latex have not been adopted up to the present, is that the methods of treatment have been too slow to deal with the large volumes of latex

obtained daily under estate conditions. This was the principal reason which led the writer to recommend "slab" rubber, which was assumed to contain not only vulcanisation accelerators formed by maturation of the coagulum (*i.e.* biologically) but also vulcanisation accelerators present in the latex and retained in the coagulum in the preparation of such rubber.

The Hopkinson Process.—The following is a description of the new process which has been patented by Hopkinson.

The latex in the form of a fine jet is fed on to a moving surface and discharged from such surface in the form of fine particles. Such a moving surface is conveniently provided by means of a disc. It is stated that the method allows of close control and produces particles of a uniform size. The rotating disc is mounted in a drying chamber with means for distributing a current of heated gas downwards which comes into contact with the comminuted particles of latex discharged from the disc. An exhaust opening is provided adjacent to the opposite end of the chamber.

The heated gas may consist of air, the products of combustion from a furnace or an inert heated gas such as carbon dioxide, etc.

It is stated that, by the use of the disc, the formation of excessively large or small particles of latex is avoided. The dust-like particles are very minute and light and difficult to recover, necessitating the use of special condensing or collecting chambers. The hot gases or air for desiccation are preferably at a temperature of over 240°Fah and impinge on the latex particles containing the highest percentage of moisture, thereby preventing "burning" or overheating. By the time the particles reach the floor of the drying chamber, the temperature has been much reduced, due to the heat absorbed by the evaporation of the water from the latex particles. The heated chamber is preferably conical in shape to prevent the tendency of the desiccated particles to deposit on the side walls.

In a description of the original patent it is stated that compounding ingredients or vulcanising agents or both may be added to the latex prior to treatment or subsequently as desired.

By varying the temperature, amount and distribution of the drying medium and size of the spraying disc, its speed of rotation and the flow of latex, the process may be regulated within wide limits to provide products of varying physical characteristics (*Note*:—This appears to suggest that latex can be concentrated to different strengths by varying the conditions).

The particles obtained appear microscopically as transparent spheres of rubber varying in size from 15 to 150 μ. The material as collected from the bottom of the chamber is very porous and spongy and if still containing moisture, can be readily dried. The dry spongy product may be compressed into blocks.

The process is said to be simple, efficient and relatively inexpensive compared with an air-spraying process by means of compressed air.

The following figures are given for chemical and physical constants of the products.

Moisture	0.9 per cent.
Extract in water	7.7 „
Ash	1.2 „

VULCANISED RUBBER (10 PER CENT OF SULPHUR.)

	Tensile strength.	Elongation
Freshly vulcanised product ...	3,900 lbs. per sq. in.	9.7
Product aged for 3 hours at 285° F. in air	3,200 „ „	9.2

The improvement of the vulcanised product over that of ordinary raw rubber is illustrated by the following figures :—

Mixing used. Rubber 100 parts, Zinc oxide 150 parts, Sulphur 10 parts.

Vulcanisation—2 Hours at 40 lbs. steam pressure.

	Ordinary milled rubber.	Sprayed Desiccated latex.
Tensile strength (lbs. per sq. inch) ...	2,000	3,100

Note.—No statement is given as to relative rates of vulcanisation and whether the time of cure in the above experiment was the optimum in both cases.

A subsequent patent includes the addition of ammonia to the latex before treatment in order to inhibit natural coagulation and also the addition of saponin, glycerine or glue and other substances to inhibit premature coagulation when vulcanising agents or compounding ingredients are added to the latex before spraying. In order to prevent natural coagulation the addition of 0.1 per cent of ammonia is recommended and to prevent coagulation on addition of vulcanising agents or compounding ingredients the addition of 0.1 per cent of saponin is proposed.

The latex and ammonia or latex plus compounding ingredients and or vulcanising agents and saponin are agitated in a tank and, while undergoing agitation, the latex is delivered in a uniform stream to an air jet and projected in a stream of finely divided particles.

The finely divided spray is passed into a chamber where it meets a stream of drying gas, preferably heated air, at about 200°F. The temperature drops to about 130°F due to evaporation of water from the particles of latex. The fine dried particles of latex are led into a tortuous channel and finally deposited in spiral collectors.

The fluid content of the latex may be reduced as desired and the dry product contains about 0.6 per cent of moisture.

The product from pure latex is porous and spongy, with small resiliency and white in colour. As collected from the chamber the product has a density of 0.3—0.4 at 70°F.

The spongy product is converted into a crude rubber mass by treatment in hydraulic presses or by passing between rolls.

The compressed rubber is stated to have a globular structure contrasted with the striated structure of ordinary rubber.

The following figures for chemical analysis of this rubber, compared with those of ordinary milled coagulum, are of interest.

	Moisture per cent.	Acetone extract per cent.	Ash per cent.	Water Extract per cent.	Protein per cent.	Acidity (as acetic acid) per cent.
Ordinary milled rubber	(Below 1)	3.0	0.4	0.5	2.0	0.02
Desiccated sprayed latex	(Below 1)	5.2	1.5	7.2	4.2	0.10

It is stated that the rubber has a neutral or alkaline character as opposed to the acid reaction of ordinary raw rubber. (The figures quoted in the table above for acidity should therefore be probably reversed.)

"*Whole*" *rubber* v. *Slab rubber.*—Whether "slab" rubber prepared from concentrated latex and containing therefore the maximum amount of (*a*) non-caoutchouc constituents of latex, including accelerators present in the latex and (*b*) vulcanisation accelerators produced by maturation, is superior from the manufacturer's point of view to "whole" rubber prepared from latex which has been evaporated or desiccated in a suitable manner, as in the process described in this paper, remains to be proved.

The disadvantages of "slab" rubber are undoubtedly the odour, moisture content and the fact that it is very tough and more difficult to treat on the crepeing machines. Whole rubber, if properly prepared, can probably be used directly by the manufacturer without further washing or drying.

Further, as indicated in the patent, the incorporation of vulcanising agents and other substances in the latex, before desiccation, thus eliminating the mixing process in the manufacture, is possible.

We have therefore a new process of preparation of a type of rubber which has been prepared on a smaller scale and by less suitable methods previously and a method or process which may eliminate the present method of preparation of sheet and crepe on the estate.

Possibilities of the Process.—The advantages of the process may be described as (*a*) Simplicity of manufacture with a minimum of labour and drying space and the fact that the rubber may be shipped on the day following the collection of the latex.

There may however be difficulties in connection with the spraying apparatus when applied to latex desiccation, which may not have been overcome yet.

(*b*) A product which should be very uniform when prepared from bulked latex, and should therefore appeal to manufacturers.

The factors which will determine the commercial utilisation of the process are (1) cost of manufacture, including cost of transport of latex to central factories. It would appear that the process is well adapted to the erection of co-operative factories for a number of estates, thus eliminating much expense in respect of buildings, plant and overhead charges. (2) Buyers' and manufacturer's prejudices, which will affect the sale. (3) Difficulties in connection with operation of the plant.

It may also be possible to concentrate latex by this process so as not to affect its quality on subsequent dilution, thus enabling a concentrated latex to be exported for purposes such as impregnation of fabric, cords for tyres, etc.

It is of interest to note that the United States Rubber Plantations, Ltd., in Sumatra, which hold the rights of the Hopkinson patent are already preparing this type of rubber.

When the vulcanising agent and compounding ingredients plus saponin are added to the latex before spraying the resistance to abrasion and the tensile strength of the vulcanised material is stated to be still further improved. This is probably due to the elimination of the milling or mixing process, which tends to break down the rubber, and also to an increase in homogeneity of the mass effected by the spraying process.

The increased quantity of protein is also stated to accelerate the vulcanisation. (Note :—This effect is probably wrongly attributed to the protein and is probably due to the inclusion of other natural accelerating agents in the rubber.

It will be seen from the above description that the Hopkinson process appears to consist of a suitable apparatus (apparently similar in many respects to an apparatus previously used for the manufacture of dried milk powder, etc.) for the commercial preparation of a dry rubber by the desiccation or evaporation of latex, producing what may be described, for lack of a better term, as " whole " rubber.

The type of rubber therefore is not new, although the method of preparation is new and appears to meet the requirements of commercial production. It might be mentioned here that the Krause apparatus for the desiccation of milk is claimed to be applicable to the desiccation of latex.

It may be of interest here to remark also that G. S. Whitby (formerly Chemist to the Société Financière et de Caoutchouc, Straits Agency, now Associate Professor of Chemistry at McGill University, Canada) actually discussed such a method of preparation with the writer before he left Malaya in 1917 and suggested the possibility of

utilising an apparatus similar to that used for the manufacture of dried milk powder.

Slab and Whole Rubber.—Before concluding this article, a few remarks on the history and comparison of slab and whole rubber appear desirable.

In researches carried out up to 1918 by the writer and his colleagues, the full details of which are published in Bulletin No. 27. "The Preparation and Vulcanisation of Plantation Para Rubber" (1918) nearly all the experiments described in connection with "slab" rubber were made on latex diluted to contain a dry rubber content of 1.5 lb. per gallon of latex or approximately 15 per cent. As is well known, undiluted latex as collected from the tree varies in its dry rubber content from about 25 to 40 per cent or even beyond these limits, due to various factors, such as method of tapping, soil conditions, age of tree, etc.

In the preparation of smoked sheet rubber in order to obtain a sheet of good appearance, (a false standard required by the market) it is necessary to dilute latex to a dry rubber content of about 1.5 lbs. per gallon, although the writer has shown that, from the point of view of the intrinsic quality of rubber, concentrated latex is preferable.

For this reason and also in order to eliminate the factor of variation in dilution, all experimental work on slab rubber was carried out by the writer and his colleagues on latex diluted to contain 1.5 lbs. of dry rubber per gallon of latex. In order to show however that in the preparation of slab rubber it was preferable to use the most concentrated latex obtainable, experiments on the effect of concentration of latex on the preparation of slab rubber were carried out and are described in Bulletin No. 27, Section 8, page 172 et seq.

The increase in rate of cure due to increased concentration of latex is indicated clearly in these experiments and is ascribed by the writer to natural vulcanisation accelerators present in the latex and retained by the coagulum in the preparation of slab rubber particularly from concentrated latex.

In all recommendations made to estates experimenting with this type of rubber, it has been stated that the highest concentration of latex obtainable under ordinary conditions should be employed, since the question of appearance of the rubber is of no importance, especially in the case of slab.

It is also stated (loc cit) page 370, para 36 that "the effect of concentration on rate of vulcanisation of rubber is probably due principally to the large amount of the natural accelerator already existing in the latex which is retained by the rubber.

It is to be inferred therefore that "slab" rubber prepared from concentrated latex is essentially "whole" rubber containing all or nearly all of the non-caoutchouc constituents of the latex, (some of which may confer other desirable properties on the raw rubber) and also containing other vulcanisation accelerators produced by the biological changes which take place during the maturation of a thick slab or block of fresh coagulum.

THE COMPARATIVE BUOYANCY OF MALAYA AND JAVA KAPOK.

By B. J. Eaton and J. H. Dennett.

THIS report contains the results of investigations which have been carried out, in order to compare samples of Kapok obtained from the Krian and Lower Perak districts of the Federated Malay States with samples of Java Kapok.

Description of Samples.—The following is a description of the various samples under examination :—

Krian Sample. —The sample as received contained the seed and a certain amount of pod which were separated by hand in the laboratory. The sample was dark cream in colour and rather more curled than the Java sample. The ultimate fibre was of similar length to the Java Kapok.

Lower Perak Sample.—The Lower Perak sample was very similar to the Krian sample.

Java Sample.—The Java Kapok, which was purchased locally was a well cleaned sample, free from seeds and pod and dark cream in colour. The fibres were straight, probably due to having been machine cleaned.

A comparison of the buoyancy of the various samples was conducted by methods similar to those described in the Bulletin Imperial Institute Vol. XVII, No. 1. January-March 1919, the main object of the investigation being to test the suitability of the Kapok for use in life-saving apparatus, for which purpose the material is now extensively used.

Analysis of Samples.—The following table shows the results of proximate analysis of the various samples, in respect of the content of moisture and ash in washed and un-washed samples.

The figures given are the mean of several estimations.

	Krian Sample.	Lower Perak Sample	Java Sample.	Java Sample Examined at Imp. Inst.	Indian Sample Examined at Imp. Inst.
	per cent.	per cent.	per cent.	per cent.	per cent.
Moisture (un-washed sample).	9.5	8.23	6.9	9.0	8.1
Ash (Dry un-washed sample).	1.57	1.09	1.16	1.3	4.4
Ash (Dry washed sample).	0.46	0.50	0.92	1.0	2.7

The figures given in the above table show that the Malaya and Java samples examined at the Department of Agriculture are very similar in respect of moisture and ash to the Java sample examined at the Imperial Institute.

British Standard for Kapok.—In connection with the application of Kapok to life-saving apparatus certain standards have been laid down in different countries and the following are those of the Board of Trade (Marine Circular No. 1572. Instructions to Surveyors. Life Jackets April 1916).*

(*a*) Life jackets intended for use by adults must be capable of supporting at least 15 lbs. of iron in fresh water for at least 24 hours.

(*b*) At least 24 ozs. of kapok must be in life belts which derive their buoyancy from that material.

(*c*) The material to be used for the cover must be unglazed unmangled and free from dressing.

Regulation (*a*) has been amended by Circular No. 1585 (Board of Trade, Marine) to read as follows :—

A life jacket whose buoyancy is derived from Kapok must be capable of supporting at least 20 lbs. of iron after floating in water for 24 hours with a 15 lb. iron weight attached.

It may be remarked here that these regulations do not appear to be sufficiently clear or detailed : *e.g.*, in the amended regulation (*a*) it is not clear whether the life jacket must be capable of supporting 20 lbs. of iron with the 15 lb. iron weight still attached, after the 24 hours test with this latter weight attached, *i.e.*, 35 lbs. after the original 24 hours' test. This would appear to be the case however from our results. Further, nothing is laid down in the above rules as to the shape or size of the life jacket or belt, whereas our experiments have shown considerable variations according to the tightness of packing, the size and shape of the cushions used in the buoyancy tests, together with the method of applying the weights in the test.

It is not stated also whether the 15 lbs. weight attached to the life jacket or cushion during the 24 hours' test is beneath the surface of the water. In our experiments the 3 lb. weight used for the 4 oz. cushions and the 15 lb. weight for the 24 oz. cushions were beneath the water.

Possibly the above rules are only a portion of other regulations prescribing the shape, size etc., of life jackets etc.

In the investigations carried out at the Imperial Institute no indication is given as to (*a*) the size or shape of the cushions used or whether the weights were placed on top of the cushions or attached below the surface or (*c*) whether the cushions were "rigid".

The results obtained were found to be modified considerably by the size and shape of the cushion employed. Thus, with a more or less rigid cushion, (*i.e.*, a flat cushion supporting a large flat iron weight, so that the shape of cushion was not altered), the results

obtained differed from those obtained by applying the same weight in the form of say a cube, which rested on a small portion of the surface of the cushion and altered the shape of the latter.

The results obtained at the Imperial Institute do not indicate also whether, at the end of 24 hours, the 3 lb. weight attached to the cushion during that period is still attached for the subsequent sinking test or whether the sinking force includes or is independent of the 3 lb. weight or whether it includes the 3 lb. weight corrected for the buoyancy of the water (N.B.:—It has already been pointed out that this is not at all clear in the Board of Trade standard).

The sinking forces given in this report are the weights placed on top of the cushions. In the 24 hour immersion tests the original weight attached during the immersion period was below the surface of the water and remained there throughout the experiment and the subsequent "sinking" force includes this weight less the weight of the water displaced by the attached weight *i.e.*, the "sinking" force is the total dead weight (apart from the weight of the cushion) required to sink the cushion. This applies to both the 4 oz. ond 24 oz. cushions.

Volume Measurements.—It was considered desirable to ascertain any difference in volume of equal weights of the various samples; this was carried out as follows:—

> 50 grammes of Kapok were placed in a wide tall glass cylinder and covered with a glass disc, which was free to slide up and down the cylinder. On the disc was placed a 1000 grm. weight and the Kapok supporting this weight was allowed to settle for two days before its final volume was measured.

The relative volume of equal weight of the various samples were as follows:—

Java sample	100
Krian sample	86
Lower Perak sample ...	85.5

The above results indicate that the Java sample would probably prove rather superior in buoyancy to the Malaya samples, which was confirmed in the buoyancy tests.

Buoyancy Tests.—The types of cushions used in the buoyancy tests are shown below and are described as "Rigid", "Non-Rigid" and "Spherical".

The rigid and non-rigid cushions are similar in shape and differ only in the type of weights attached, which affects the final shape of the cushion. The spherical cushion was made of such a size that the Kapok was compressed into half thetvolume occupied in the other types of cushion.

The size of the cushions used for the 4 oz. samples of Kapok were 9⅝ ins. × 13¼ ins.: the covers were made of coarse undressed butter muslin of about 4600 meshes per sq. inch.

In the tests it was found that three successive sinkings of the same cushion did not give identical results and the figures given in the following table are the mean of three sinkings in each test.

Sample.	Sinking force in Ozs.		Sinking force in Ozs.			Remarks.
	(A) On first immersion.	(B) After 24 hours with 3 lbs. weight attached.	(C) Weight of water absorbed after Test B.	(D) After total immersion for 5 days.	(E) Weight of water absorbed after Test D.	
Java.	102.3	112.3	2.0			Non-Rigid.
„	108.8	110.4	2.3			do.
„	111.0	111.0	...	111	3	Rigid.
„	103	114.0	1.4			do.
„	112	...	...			Non-Rigid.
„	102.5	122	1.4			Rigid.
„	109.3	...	...			Non-Rigid.
„	113.6	90	3.9			do.
Mean.	108.4	100	2.2			do.
Krian.	96	104.5	1.5			Non-Rigid.
„	104.5	109.5	2.0			do.
„	96	101	2.0			do.
„	96	95 5	2.0			do.
„	103.5	113	1.5			do.
„	98	97	2.0			do.
Mean.	99	103.5	1.8			...
L. Perak.	106.3	110	2.3			Non-Rigid.
„	114	103.5	...			Rigid.
„	114.3	104.6	...			do.
„	95	106	2.0			do.
„	105.3	...	...			Non-Rigid.
„	98.6	91	3.7			Rigid.
„	95.3	106	2.1			do.
Mean.	104.7	103.5	2.0			...
Java.	70.8	68.0	...	60.4	14	Approximately spherical. Kapok compressed.
Krian.	65	66.6	3.5			
L. Perak.	65	67	3.0			

In the case of the samples left under water for five days decomposition of the fibre occurred, evolving a putrid odour, due to the presence of organic nitrogenous matter. The odour resembled that evolved in the retting of various fibres in stagnant water.

The sinking forces (after 24 hours with 15 lbs. of iron attached) for 24 oz. cushions of kapok, calculated from the mean results obtained for the different samples in the above table are as follows :—

Java Kapok	...	...	41.2 lbs.
Krian Kapok	...	...	38.8 „
Lower Perak Kapok	...	...	38.8 „

The results calculated from the tests carried out on spherical cushions containing the kapok compressed into half the volume are: —

Java Kapok	25.6 lbs.
Krian Kapok	25.0 „
Lower Perak Kapok	25.1 „

It will be seen that, even under the most rigid of the above tests, the Malaya kapok, although slightly inferior to the Java sample is well above the requirements of the Board of Trade Standard.

The above results on 1 oz. cushions, were confirmed by a few tests made on 2 oz. cushions, the following results being obtained:

Weight required to sink Rigid Cushions containing 2 ozs. Kapok

	Immediately.	After 24 hours with 15 lbs. of Iron attached.
Java Kapok	40.4 lbs.	41.0 lbs.
Krian „	37.2 „	38.2 „
Lower Perak Kapok ...	37.1 „	38.0 „

The following results obtained in tests carried out at the Imperial Institute on behalf of India are given for comparison. (Reference: - Supplement to the "Indian Trade Journal" August 15 1919).

Weights required to sink a bag containig 4 ozs. floss in fresh water.

Sample.	(A) Immediately after immersion.		(B) After 24 hours in water with 40 ozs. iron attached.		(C) Weight of water absorbed after experiment B.	Calculated weight (lbs.) Supported by 24 ozs. of Kapok, after 24 hours immersion with 15 lbs. of iron attached.	
	ozs.		ozs.		ozs.		
Commercial Java Kapok.							
(1)	83	82.5	87	89	3	32.6	33.3
(2)	82		91			34.1	
Togoland Kapok...	78		78		...	29.3	
Indian Kapok ...	99	77	97	102	3	36.1	38.2
Indian "Machine cleaned" in India	107		107			40.1	
Akund Flooss	80	77		69	14	25.9	
Akund "Machine cleaned" in India	74						
	45		...		...	16.9	

Note. —The Java and Togoland kapok were derived from *Eriodendron Anfractuosum*, which is similar to Malaya kapok. The Indian kapok was derived from *Bombax sp.* while the Akund floss is derived from *Calotropis sp.*

The following table shows the results obtained on 24 oz. samples and also calculated for 24 oz. samples from the tests on the 4 oz samples.

Samples.	A Immediately after immersion.	B After 24 hours with 15 lbs. of iron attached.	C Weight of water absorbed.	D Further immersion with 15 lbs. of iron attached.		E Weight of water absorbed after experiment. D
	lbs.	lbs.	lbs.	24 hrs.	44 hrs.	lbs.
Commercial Java Kapok 24 oz. sample	30.3	31.5	0.94	19.5	...	10.3
Java Kapok (calculated for 24 ozs. from small scale tests).	30.9	33.5	1.13	...	23.6	8.4
Indian Kapok (24 oz. sample).	45.5	42.3	1.0	18.0	...	12.5
Indian Kapok (calculated for 24 oz. sample from small scale test.)	38.6	38.2	1.3	...	21.7	10.6

Summary.

The results of this investigation show that the Malaya samples are only slightly inferior to the Java samples and are well above the Board of Trade Standard.

The results obtained under different conditions of testing indicate also the desirability, in connection with the standards adopted, of laying down a few more details in respect of the conditions under which the tests should be carriedout.

CASHEW NUT OIL.

By C. D. V. Georgi.

A series of experiments with Cashew Nut Oil (Minyak buah janggus) has been carried out recently in view of a suggestion that this oil might be utilised in pharmaceutical preparations in a similar way to Almond Oil.

Cashew nut oil is obtained from the kernels of the fruit of *Anacardium occidentale*, a tree which is found widely distributed throughout tropical regions. In the Malay Peninsula the tree occurs principally in the coastal districts of Pahang and it was from that State that the supplies of nuts for the present investigation were obtained.

Description of Fruit.

The fruit is kidney-shaped, about 1¼ inches long, dark brownish grey in colour and weighs about 5 grams. The shell is hard and leathery on the surface, but cellular in the interior and contains a brownish black oil which is a strong vesicant. The kernel is covered with thin reddish yellow skin, the flesh itself being yellowish white.

It may be mentioned here that the kernels are eaten as a dessert nut, both in countries where the tree grows and also in Europe. Further, they are used in the manufacture of nut chocolate and other sweetmeats, where they are frequently employed as a substitute for almonds.

Oil Content.

The results of the analysis of two samples of the nuts were as follows.

	Per. cent.	Per. cent.
Proportion of husk. ...	30.8	30.8
Proportion of kernel ...	69.2	69.2
Kernel.		
Moisture.	9.7	8.1
Oil (Chloroform extract) ...	37.8	33.5
Residue (by difference) ...	52.5	48.4
Oil (on dry kernel) ...	41.9	41.3

Expression of Oil.

In connection with the preparation of the requisite sample of oil for valuation[1], an experiment was carried out to ascertain the percentage of oil which could be expressed by using a small laboratory hand-press.

1. The sample of oil has been despatched to the Malay States Information Agency, 88 Cannon Street, London E. C. 4 and the result will be published in due course.

On account of the somewhat slimy nature of the kernels when crushed the latter had to be partly dried before pressing, to prevent contamination of the oil by meal.

The crushed kernels were dried for about three hours at a temperature of about 80° C. and pressed. The operation was repeated and the residue in the press analysed.

The results were as follows.

	Per. cent.
Moisture ...	7.7
Oil (Chloroform extract)	22.5
Residue (by difference)	69.8
Nitrogen ...	3.74

Assuming therefore that the kernels had an oil content of about 43 per cent, it will be seen that only about 50 per cent of oil has been expressed.

The oil was clear, brownish yellow in colour, with a faint smell and a bland taste. There was no deposit on standing.

Characteristics of Oil.

The results of the determination of the physical and chemical constants of the oil were as follows. The figures for Almond oil taken from Lewkowitsch, "Chemical Technology and Analysis of Oils, Fats and Waxes," Fourth Edition, Volume II, page 235 are given for purposes of comparison.

Oil.	Cashew Nut Oil.	Almond oil.
Density at 15.5°C. ...	0.919	0.917-0.919 (15°C)
Refractive Index at 20°C. ...	1.4770	1.4705
Saponification value. ...	187.3	189.5—195.4
Iodine value (Wijs) ...	78.4	93—101.9
Acidity (Oleic Acid per cent)	5.5	
Unsaponifiable (per cent) ...	0.6	
Fatty Acids.		
Solidifying Point (Titer value)	28°C.	9.5—11.8°C.
Mean Molecular Weight. ...	284.6	

Results of Experiments.

The experiments show that the kernels of the Cashew nuts are rich in oil, containing between 40 and 45 per cent. The nature of thh kernel is such that it will require a high pressure to extract the maximum quantity of oil.

The decortication of the nuts is a difficult problem in view of the leathery nature of the shell and the presence of the vesicant liquid.

The cake remaining after the expression of the oil is rich in albuminoids. In the sample obtained from the small laboratory hand-press it amounts to 23.4 per cent of albuminoids, corresponding to 33.4 per cent on the dry oil-free residue.

EXPORT OF PLANTS SEEDS, ETC., TO ENGLAND AND WALES TO SCOTLAND AND TO OTHER COUNTRIES.

(*Vide Gazette No. 84 of 1st December, 1922.*) *No. 6487/22.*

IT is notified for information that the Destructive Insects and Pests Order of 1922, which came into force in England and Wales on the first day of July, 1922, revoked the Destructive Insects and Pests Order of 1921. Notification No. 1933, published in the *Gazette* of 2nd December, 1921, and made under the Order of 1921 is hereby cancelled.

The Destructive Insects and Pests Order of 1922 prohibits the landing in England and Wales, from any country other than Scotland, Ireland and the Channel Islands of the following categories of plants, seeds, etc., unless the consignment is accompanied by a certificate of freedom from disease issued at the time of packing and not more than 14 days prior to despatch by a duly authorised official of the country from which it is exported :—

(*a*) all living plants with a persistent woody stem above ground, and parts of the same, except seeds, when in use for propagation—such as fruit trees, stocks and stools, forest trees, and ornamental shrubs and grafts, layers and cuttings thereof ;

(*b*) all potatoes ; and all tubers, bulbs, rhizomes, corms and hop stocks for planting ;

(*c*) seeds of onions and of leeks for sowing ; and

(*d*) gooseberries.

An Order, the Destructive Insects and Pests (Scotland) Order of 1922, which came into force on the 1st day of August, is in similar terms and requires identical certificates for entry into Scotland.

For entry into England and Wales and into Scotland of these categories of plants, seeds, etc., *by post* a copy of the certificate must be attached to the package : for entry by other means, two copies of the certificate are required ; one must travel with the consignment ; the other must be produced to the Customs officer at the port of entry. In neither case will the original certificate pass into the Exporter's hands ; but it will be sent, after the issue of the required copy or copies, by the inspecting officers to the Horticultural Division of the Ministry of Agriculture and Fisheries.

It is anticipated that an Order similar to those in force in England and Wales and in Scotland will shortly be made by the Ministry of Agriculture, Northern Ireland.

There are other countries which require the production of a certificate of freedom from insect pests or fungus disease, before permitting the importation of living plants or part of plants. Amongst the countries in which such a certificate is necessary or useful are Queensland, Victoria, South Australia, New Zealand, Peru, Ceylon, Mauritius and Algeria.

1. When a certificate is desired by any person desiring to export plants or parts of plants from the Colony to England and Wales, to Scotland, or to any of the other countries mentioned above, application should be made well in advance to the Director of Gardens, Singapore, or the Assistant Curator, Waterfall Gardens, Penang. The application must be made in the Form A below (which will be supplied upon request) or must furnish the information required by the Form, in order that the officers of the Gardens Department may make arrangements for the inspection.

2. Applicants will be asked to bring or to send to the Botanic Gardens, Singapore, or to the Waterfall Gardens, Penang, all small consignments, and when it has been found possible to give a clean certificate, to leave them in the hands of the inspecting officer for despatch. If, however, the applicant wishes to despatch the consignment himself and is personally known to the inspecting officer, he at the descretion of the inspecting officer may be permitted to retain possession of his consignment on giving an undertaking in writing to despatch under the certificate nothing but what has been inspected.

3. Large consignments and such as can only be brought or sent to the Botanic Gardens, Singapore, or the Waterfall Gardens, Penang, with difficulty, will be examined by an inspecting officer at some place to be arranged, and on the giving of a clean certificate after such inspection, the consignor must give an undertaking in writing to despatch under the certificate nothing but what has been inspected.

4. The following fees have been prescribed under the Fees Ordinance, 1881, for inspections made at the Botanic Gardens, Singapore, or at the Waterfall Gardens, Penang:—

		$	c.
(i)	for ispecting a postal packet including the posting of it, the consignor furnishing postal labels and stamps	1	50
(ii)	for inspecting a package weighing less than eleven pounds, including the putting of it on a boat or on a train, the consignor paying the freight from Singapore or Penang	2	00
(iii)	for each additional package weighing less than eleven pounds being part of the same consignment	1	00
(iv)	for inspecting a package of seed or fruit weighing more than eleven pounds or less than one hundredweight including the putting of it on a boat or on a train, the consignor paying the freight from Singapore or Penang	3	00

(v) for each additional package weighing more than eleven pounds and less than one hundredweight, which may form part of the same consignment 1 00

(vi) for inspecting a package of living plants weighing more than eleven pounds and less than one hundredweight at the Gardens, including the putting of it on a train or on a boat, the consignor paying the freight 4 25

(vii) for each additional package weighing more than eleven pounds and less than one hundredweight which may form part of the same consignment 2 00

5. The fee, when an inspection of a consignment is made at any other place than the Gardens, will be at the rate of $2 per hour of the Inspector's time in addition to the cost of his travelling expenses to and from the place of inspection, the minimum fee being $5.

FORM *A*.

APPLICATION FOR A CERTIFICATE OF FREEDOM FROM INSECT PESTS AND PLANT DISEASES.

Number and Description of packages in consignment.....

.....

Distinguishing Marks.....

Description of Plants.....

Grown at.....

Since the date of.....

Name and Address of Exporter.....

.....

Name and Address of Consignee

Name of Vessel.....

Date of Shipment.....

Port of Shipment.....

Port of landing in England and Wales or in Scotland, or elsewhere.....

.....

Approximate Date of Landing.....

Date.....Signed.....

The particulars contained in Form *A* above have also to be filled in by the shipper on each copy in the Certificate.

Abstract of Meteorological Readings in the various Districts of Malaya for the month of October, 1922.

District.	Mean Barometrical Pressure at 32° Fah.	Maximum in Sun.	Temperature.				Hygrometer.				Prevailing Direction of Winds.	Total Rainfall.	Greatest Rainfall during 24 hours.
			Mean Dry Bulb.	Maximum.	Minimum.	Range.	Mean Wet Bulb.	Vapour Tension	Dew Point.	Humidity.			
Kelantan, Kota Bahru	...	144.94	80.3	90.22	73.64	16.58	75.1	.774	71.6	75%	...	10.67	5.32
Pahang, Kuala Lipis	...	...	80.9	89.8	70.4	19.5	76.2	...	...	...	...	7.23	2.00
Johore, Johore Bahru	...	...	...	86.48	73.08	...	...	...	...	...	...	11.19	1.84
Singapore, Kandang Kerbau	...	...	82.2	87.8	74.2	...	78.1	.823	...	82.	Calm	10.58	1.73
Malacca, Durian Daun	...	123.	82.	87.	74.	13.	78.	.902	...	83.	N.W.	11.18	2.24
Negri Sembilan, Seremban	...	151.2	79.1	90.4	70.9	19.5	76.2	.863	74.1	85.	N.E.	9.74	1.61
,, Kuala Pilah	...	154.1	81.1	89.1	70.6	18.5	77.6	.876	75.2	82.9	N.E.	6.37	.91
,, Port Dickson	...	148.6	81.6	87.2	73.9	13.3	77.6	.869	75.5	80.8	...	14.74	1.12
Selngor, Kuala Lumpur	...	150.8	81.5	89.4	72.2	17.2	76.6	.823	73.3	76.	S.W.	9.18	2.48
,, Klang	...	...	80.0	84.4	74.2	10.2	76 5	...	...	...	...	15.52	2.44
,, Kuala Selangor	...	...	...	89.6	69.7	19.9	...	...	...	...	...	7.55	1.81
,, Rawang	...	...	...	...	...	...	...	...	...	...	...	...	...
Perak, Telok Anson	...	...	80.69	92.	70.	22.	76.84	.873	...	85.	...	16.63	3.81
,, Ipoh	...	...	80.38	92.	71.	21.	75.98	.840	73.8	82.	...	10.35	2.71
,, Taiping	...	...	80.37	92.	71.	21.	76.26	.850	...	82.	...	23.50	4.33
,, The Cottage	...	...	...	...	...	...	...	...	...	...	...	56.02	10.70
,, Parit Buntar	...	...	81.80	92.	71.	21.	77.51	.888	...	83.	...	11.18	2.12
Penang, George Town	...	...	...	...	...	...	...	...	...	...	...	...	...
Kedah, Alor Star	...	...	...	...	...	...	...	...	...	...	...	13.42	2.30
Perlis, Kangar	...	...	...	87.61	73.39	14.22	...	...	...	...	...	14.55	2.88

Abstract of Meteorological Readings in the various Districts of Malaya for the month of November, 1922.

District.	Mean Barometrical Pressure at 32° Fah.	Maximum in Sun.	Temperature.				Hygrometer.				Prevailing Direction of Winds.	Total Rainfall.	Greatest Rainfall during 24 hours.
			Mean Dry Bulb.	Maximum.	Minimum.	Range.	Mean Wet Bulb.	Vapour Tension.	Dew Point.	Humidity.			
Kelantan, Kota Bahru	...	138.33	80.0	87.46	73.90	13.56	75.7	.807	72.8	78%	...	22.28	6.63
Pahang, Kuala Lipis	...	...	80.0	89.5	70.1	19.4	75.8	...	...	...	...	8.51	3.20
Johore, Johore Bahru	...	...	...	87.38	73.68	...	...	...	...	...	...	22.88	3.55
Singapore, Kandang Kerbau	...	...	82.6	87.1	76.8	...	77.9	.910	...	84.	Calm	16.68	4.01
Malacca, Durian Daun	...	115.	82.	86.	74.	12.	78.	.907	...	83.	N.	11.92	1.88
Negri Sembilan, Seremban	...	147.9	79.8	90.1	72.9	17.2	76.7	.855	74.6	84.4	E.	8.10	1.02
,, Kuala Pilah	...	143.3	80.1	86.9	70.6	16.3	77.5	.891	75.7	86.9	...	15.81	2.75
,, Port Dickson		146.0	81.1	86.1	74.1	12.0	77.7	.874	75.2	82.4	...	5.80	1.85
Selangor, Kuala Lumpur	...	150.9	80.1	87.4	73.0	14.4	76.2	.833	73.6	81.3	N.E.	7.98	1.21
,, Klang	...	...	79.7	85.0	74.8	10.2	77 0	...	...	...	...	6.89	1.55
,, Kuala Selangor	...	...	...	89.1	69.1	20.0	...	...	...	...	...	14.51	3.49
,, Rawang	...	...	...	...	...	...	...	...	...	...	...	...	...
Perak, Telok Anson	...	...	80.34	92.	71.	21.	76.80	.876	...	85.	...	6.06	1.10
,, Ipoh	...	...	80.04	93.	72.	21.	75.98	.843	73.73	82.	...	13.97	2.36
,, Taiping	...	...	80.74	91.	72.	19.	76.86	.873	...	85.	...	13.03	2.55
,, The Cottage	...	...	...	...	...	...	...	...	...	...	...	57.79	8.18
,, Parit Buntar	...	...	80.93	92.	72.	20.	77.19	.883	...	85.	...	8.26	1.37
Penang, George Town	...	151.	82.9	91.	70.	21.	79.1	.942	72.3	83.8	N.W.	12.97	4.17
Kedah, Alor Star	...	...	...	...	...	...	...	...	...	...	...	12.08	2.22
Perlis, Kangar	...	...	...	84.96	72.83	12.13	...	...	...	...	...	6.9	1.76